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(54) [Title of Invention]
FLUORESCENCE OBSERVATION APPARATUS

(57) [Abstract]
[Purpose]
To provide a fluorescence observation apparatus capable of detecting fluorescence images and normal observation images by a common imaging device without causing any damage such as sticking to the imaging device.

[Constitution]
Excitation light generated from a laser 9 and illumination light generated from a xenon lamp 11 irradiate tissue 3 in a time-divided manner by such as a first filter 12 and a rotatable shutter 13 of which timing is controlled by a timing controller 7. A fluorescence image and a normal image, via a second filter 17 synchronously rotated with an objective lane 16, the first filter 12, etc., are detected by a common CCD 18 in a time-divided manner. By passing the images through a two-dimensional lock-in amplifier, in particular, the S/N ratio of the fluorescence image can be greatly improved, level imbalance between the fluorescence image signal and the normal image signal can be reduced, problems of sticking, etc. can be eliminated, and two images can be displayed on a monitor 8.

[Claims]
[Claim 1]
A fluorescence observation apparatus capable of displaying both an observation image by normal light and a fluorescence image based on the excitation by the excitation light simultaneously or display two images by switching in a time-divided manner, which is characterized by having:
a light irradiation means which irradiate said illumination light and the excitation light;
a selection means which selects an observation image by the reflected light from the tissue irradiated with said illumination light or fluorescence image from the tissue irradiated with said excitation light;
an image detecting means which detects the image being selected by said selection means by synchronizing with said light irradiation means;
an image processing means which performs a differential calculation and/or a integration of the images detected by said image detecting means;
a control means which synchronously controls said light irradiation means, selection means, image detecting means, and image processing means.

[Detailed Description of the Invention]
[0001]
[Technical Filed]
This invention relates to a fluorescence observation apparatus capable of acquiring an observation image by normal light and a fluorescence image by excitation light.

[0002]
[Prior Art]
In recent years, there are techniques such as auto-fluorescence generated from living tissue and drug-induced fluorescence generated by injecting a fluorescent drug into the organism beforehand and produce two-dimensional images which are used to diagnose the degeneration of tissues of the organism

or a state of the disease (for example, the type of the disease or the extent of infiltration), such as cancer.

[0003]
If light is irradiated to living tissue, the fluorescence of a wavelength longer than that of the excitation light will be emitted.
Fluorescence substances in the organism are, for example, collagen, NADH (nicotinamide adenine dinucleotide), FMN (flavin mononucleotide), pyridine nucleotide, etc. Recently, the interrelation between these substances in the organism emitting fluorescence light and diseases is becoming clear, and the diagnosis of cancer, etc. is possible from this fluorescence.
Alternatively, a fluorescence substance such as HpD (hematoporphyrin), Photofrin, ALA(δ-amino levulinic acid), etc., may be injected into an organism. These substances have a tendency to accumulate in cancerous tissue, and a diseased area can be diagnosed by observing the fluorescence after injecting any of these substances into an organism.

[0004]
Since the fluorescence mentioned above is extremely weak, a super sensitive photography is required to observe the fluorescence. Image intensifier is widely known to perform this supersensitive photography. Recently, a fluorescence observation apparatus for observing fluorescence light has been suggested which performs two-dimensional synchronizing detection as shown in Fig. 12 so as to improve the sensitivity thereof.

[0005]
First, continuous laser beams are emitted by a laser beam apparatus 201, the laser beams are chopped at high speed by a chopper 202 with 1/600 sec clocks generated by a clock generator 220, the laser beams are enlarged by a concave lens 203 before tissue 204 is irradiated with the enlarged laser beams, fluorescence light emitted by the tissue 204 is allowed to pass through a lens 205 and a filter 206 so that fluorescence light is captured by a CCD 207.

[0006]
The filter 206 is a band-pass filter which cuts the laser beam and which permits only wavelengths longer than that of the laser beam, that is, which permits only fluorescence light to pass through. At this time, fluorescence light is generated in synchronization with turning on/off of excitation light so as to be detected by the CCD 207 while being chopped as described above, that is, being synchronized with the period of 1/600 sec. Detected fluorescence light is formed into an image signal by a video processor 208 and is converted into a digital data by an A/D converter 209.

[0007]
The multiplexor 210 is switched at the clock timing of 1/600 sec so that digital data is divided into ODD and EVEN frames, that is, digital data is divided into images formed when fluorescence light is being generated and images formed when fluorescence light is not being generated (the reverse permitted), and the divided images are stored in frame memories 211 and 212. Data stored in the frame memories 211 and 212 are difference-calculated by a differential circuit 213 at a period of 1/300 sec (divided by clocks in a dividing circuit 214). Furthermore, the results of the difference-calculations are, about 10 times, integrated by an integrating circuit 215. Thus, noise can be canceled and a required signal can be amplified so that the S/N ratio of the signal is improved.

[0008]
The signal is, then, formed into a video signal by a video processor 216 and is displayed on a monitor 217. Reference numeral 219 shown in FIG. 12 represents a two-dimensional lock-in amplifier portion for improving the S/N ratio.

[0009]
On the other hand, as for fluorescence observation, it is important observe images by a normal screen as well as a fluorescence image when an orientation is performed. In order to obtain both a fluorescence image and a normal image, a plurality of cameras have been used or one camera has been used for imaing in a time-divided manner so as to obtain the two types of the images.

[0010]
[Problems to be Solved by the Invention]
However, the foregoing case where the fluorescence image and the normal image are detected by corresponding cameras involves a problem that the structure of the apparatus becomes too complicated and the size of the image detecting portion cannot be reduced.
When one camera is used to perform the image detection in a time-divided manner as described above, any excessive differences between the intensity of received light from the fluorescence image and that from the normal image causes the fluorescence image to be darkened unsatisfactorily, halation to take place in the normal image which results in sticking.

[0011]
This invention is formed in consideration described above and aimed to provide a fluorescence observation apparatus with a simple structure which is capable of detecting excellent fluorescence images and normal images by one camera without a risk of sticking.

[0012]
[Means to Solve the Problems and Effects]
A fluorescence observation apparatus is provided with:
a light irradiation means which irradiate normal light and excitation light in a time-divided manner;
a selection means which selects an observation image by illumination light or a fluorescence image by excitation light irradiated to an area to be observed;
an image detecting means which captures the observation image or the fluorescence image selected by the selection means in synchronization with the light irradiation means; an image processing means which performs difference-calculation and/or integration of the image captured by the image detecting means; and
a control means which synchronous-controls said light irradiation means, selection means, image detecting means, and image processing means.
With this structure, it is possible to capture images with one camera and the S/N ratio of a fluorescence image can be improved by the image processing means and halation in normal image can be prevented.

[0013]
[Embodiment]
Hereafter, embodiments of this invention will be explained referring to drawings. Fig 1 through Fig. 3 relate to a first embodiment of this invention, Fig. 1 illustrates a structure of a fluorescence observation apparatus of a first embodiment, Fig. 2 illustrates an example of a fluorescence intensity distribution in a normal area and a diseased area, and Fig. 3 is a timing chart explaining the operation of the first embodiment. An apparatus of the first embodiment detects both fluorescence images and observation images by a common image detecting device in a time divided manner.

[0014]
The fluorescence observation apparatus 1 of the first embodiment shown in Fig. 1 comprises: a light source apparatus 2 for generating illumination light for normal observation and excitation light for fluorescence observation; an image detecting apparatus 4 for detecting a normal image and a fluorescence image of tissue 3 which is a subject to be observed; a two-dimensional lock-in amplifier 5 for amplifying the images detected by the image detecting apparatus 4 and improving the S/N ratio; an image processing apparatus 6 which divide said images into normal image and fluorescence image and processed respectively and comprises each images; a timing controller 7 which synchronous-controls said light source apparatus 2, image detecting apparatus 4, two-dimensional lock-in amplifier 5, and image processing apparatus 6; a monitor 8 which displays the images passed through said image processing apparatus 6.

[0015]
The light source 2 comprises:
a laser 9 (for example, an excimer laser, a krypton laser, a He-Cd laser and a dye laser could be used) for generating excitation light having wavelength at λ_0 (for example λ_0 = 350 nm – 500 nm) (abbreviated to excitation light λ_0);
a chopper 10 which is rotated in such a manner that tooth-like portions formed on the periphery of a light-shielding disc are provided so as to cause excitation light to be turned on and off at a period of 1/720 sec, for example and the periphery portion is arranged on the optical path of the laser light;
a xenon lamp 11 which generates illumination light to observe a normal image;
a first rotatable filter 12 which is rotated at 1/30 sec by a motor (not illustrated) and has a color filter of R,G, and B arranged on the optical path for the illumination light;
a rotatable shutter 13 which is arranged on the optical path for the laser light and which is rotated at 1/30 sec in synchronization with the first rotatable filter 12 to pass through or shield laser light, and
a dichroic mirror 14 which is placed while being inclined by an angular degree of 45 degree from the optical path for illumination light and positioned on the optical path for laser light so as to reflect only excitation light λ_0; and
an illumination lens 15 which is arranged in front of the optical path of the dichroic mirror 14 for irradiating light to tissue 3 by enlarging.
That is, the light source apparatus 2 alternately irradiate the laser light which is a pulse-formed excitation light and the illumination light of R, G, and B.

[0016]
The image detecting apparatus 4 comprises: an objective lens 16 for connecting optical images of the tissue 3; a second filter 17 which is arranged on the objective lens 16 and rotated by a motor (not illustrated) at 1/30 sec so as to synchronize with the

first filter 12 and the rotatable shutter 13 and pass through fluorescence images (fluorescence having wavelengths at λ_1 and λ_2 longer than λ_0) and normal images; a CCD 18 serving as an image detecting device for capturing said fluorescence and normal images by a time-divided manner; and a video processor 19 for converting into video signals while operating the CCD 18.

[0017]
The video processor 19 and the second filter 17 are controlled by the timing controller 7 so that the video processor 19 generates image signals for a single frame at a high speed period of 1/1440 sec, which is half of 1/720 sec.

[0018]
The two-dimensional lock-in amplifier 5 comprises: an A/D converter 20 for converting the image signal into digital data; a multiplexor 21 for distributing image data to a frame memory (ODD) 22a and a frame memory (EVEN) 22b for each frame to correspond to turning on and off of excitation light of the laser 9 in synchronization with the timing controller 7; a difference-calculating circuit 23 for difference-calculating the frame memory (ODD) 22a and the frame memory (EVEN) 22b so as to cancel noise components for the purpose of improving the S/N ratio; and an integrating circuit 24 that integrates (in such a manner that the same image portions are respectively accumulated) images from which noise components have been canceled so as to improve the S/N ratio and amplify the image. The normal image is not allowed to pass through the frame memories and the difference-calculating circuit but it is directly received by the integrating circuit 24.

[0019]
The image processing apparatus 6 comprises: a multiplexor 28 for distributing normal and fluorescence image data amplified by the two-dimensional lock-in amplifier 5 to a normal image storing frame memory (consisting of red, green and blue frame memories) 25, a λ_1-image storing frame memory 26 and a λ_2-image storing frame memory 27 in synchronization with the timing controller 7; a calculating circuit 29 that calculates the λ_1-image storing frame memory 26 and the λ_2-image storing frame memory 27 in order to clarify the characteristics of the tissue in accordance with the fluorescence image; a superimpose circuit 30 for synthesizing the image in the normal image storing frame memory 25 and that in the calculating circuit 29; and a computer 31 for controlling the superimpose circuit 30 and the timing controller 7.

[0020]
Next the operation of this embodiment will be explained.
First, excitation light formed into pulses at a period of 1/720 sec, for example, and observation light (R, G, and B) at a period of 1/30 sec, for example, from the light source apparatus 2 is alternately irradiated to tissue 3 in a time-divide manner.

[0021]

Fig. 3 shows the timing of the chopper 10 with the rotatable shutter 13, the first filter 12 and the second filter 17. The rotatable shutter 13 and the first filter 12 are alternately opens and the second filter 17 is synchronized with the rotatable shutter 13 and the first filter 12. That is, while excitation light is irradiated to tissue 3 when the rotatable shutter 13 open, filter for λ_1 and λ_2 are sequentially arranged on the observation optical path. When normal light (R, G, and B) is irradiated to the tissue 3, filter is removed. In addition, excitation light is turned on and off by the chopper 10 at a period of 1/720 sec.

[0022]
More specifically, the rotatable shutter 13 as shown in Fig. 3 (a) is opened for two thirds of 1/30 second and this period is as shown in Fig. 3 (b) the first filter 12 becomes a light shielding part (shown as Closed) and laser light is turned on and off by the chopper 10 which is opened/closed as shown in Fig. 3 (d) and the rotatable shutter 13 passes through a pulse-formed excitation light λ_0. (During this period, the first filter 12 becomes a light-shielding part and blocks R, G and B light) After the excitation light λ_0 is reflected by the dichroic mirror 14 and passed through the lens 15, it is irradiated to the tissue 3 and fluorescence light having the wavelength longer that that of excitation light λ_0 is emitted.

[0023]
The wavelength component of this fluorescence light which passed through the second rotatable filter 17 by the objective lens 16 is reached to the CCD 18 and a fluorescence image is formed. The second rotatable filter 17 shown in Fig. 3 (c) arranges the filter for λ_1 and λ_2 sequentially on the image detecting optical path and fluorescence image of λ_1 and λ_2 are detected at a period of 1/90 seconds.

[0024]
The remaining third of the period of 1/30 second for the rotatable shutter 13 is a period in which laser light is shielded. In this shielded period, the red, green and blue filters of the first filter 12 are sequentially placed

on the optical path so as to irradiate one light among these R, G, B lights is supplied (for example red illumination light is output) after it is allowed to pass through the dichroic mirror 14 so as to be introduced into the tissue 3 via the lens 15.

[0025]
The R illumination light for example reflected from the tissue 3 passes through the second rotatable filter 17 by the objective lens 16 and a R image is formed on the CCD 18. The opening portion of the second rotatable filter 17 is arranged on the image detecting optical path during this period as shown in Fig. 3 (c). (in Fig. 3 (c), it is shown as no filter.) At the same timing in the next period, irradiation and image detection with green light are performed and then those with blue light are performed. That is the image detecting operation is performed by the image detecting apparatus which contains the CCD 18 in a time-divided manner to correspond to excitation light and normal light in a time-divided manner.

[0026]
As described above, the portions of the fluorescence images that have the wavelengths λ_1 and λ_2 and the normal image are, by the common image detecting apparatus 4, converted into image signals at the period of 1/1440 sec, which is the half of the foregoing period of 1/720 sec. That is, in synchronization with turning on and off of excitation light. Each of R, G and B irradiation light beams is continuously
applied for each 1/90 sec in such a manner that the corresponding images
are repeatedly read at the period of 1/90 sec to 1/1440 sec.

[0027]
The high speed image signal is supplied to the two-dimensional lock-in amplifier 5 so that its S/N ratio is improved and the signal level is amplified. In particular, the fluorescence image is subjected to a difference-calculating process in the difference circuit 23 in a manner such that the differences between light images and dark images formed due to turning on and off are processed. Thus, the influence of noise that is not related to turning on and off and that of 1/f noise which becomes critical by low frequency waves can significantly be eliminated. Therefore, weak image signals of a fluorescence image can be formed into fluorescence image signals exhibiting excellent S/N ratio.

[0028]
Therefore, the fluorescence image signal transmitted by the difference circuit 23 can be set to a level free from excessive imbalance as compared with the level of an image signal obtained in a normal observation. By supplying the result of the image capturing operation to the two-dimensional lock-in amplifier 5, level imbalance between the fluorescence image signal and the normal image signal can be eliminated satisfactorily. Therefore, a necessity of providing a circuit for considerably increasing the gain in order to raise the level of the fluorescence image for a position in the signal processing system can be eliminated. Furthermore, problems of halation and sticking that takes place frequently in the normal image portion can be overcome.

[0029]
Since the brightness (the intensity) of fluorescence is changed due to the intensity of excitation light, the type of a fluorescence material and the efficiency of fluorescence generation, it is more effective to change the amplifying ratio by changing the number of the integrating operations performed by the integrating circuit 24 or by performing a process using a digital window (the number of bits increases due to the number of the
integrating operations and the gain is changed by the portion of the bit from which the data is taken by cutting).

[0030]
The amplified image signals are divided into the fluorescence image and the normal image by the image processing apparatus 6 so that the respective images are converted into image data suitable to be displayed. Then, the images are synthesized by the superimpose circuit 30 so as to be displayed on the monitor 8.

[0031]
Fig. 2 shows the fluorescence characteristics when a subject area to be observed is irradiated with excitation light λ_0. Fluorescence light from tissue obtainable due to irradiation with excitation light λ_0 having a wavelength of 442nm is intense in a healthy area and is weak in a diseased area in a short wavelength region thereof as compared with the intensity of the healthy area. That is, the ratio of the intensities of fluorescence light having the wavelengths λ_1 and λ_2 becomes different between a healthy area and a diseased area. Therefore, the ratio of the image areas having the wavelengths λ_1 and λ_2 is obtained to distinguish "diseased" and "healthy".

[0032]
Calculation of the images in the frame memory 26, which stores the image detected at the wavelength λ_1, and the frame memory 27, which stores the image

detected at the wavelength λ_2 to obtain the difference of intensities in each corresponding portion of the images is performed by the calculation circuit 29 in order to determine whether or not the value is greater than a predetermined value. If the ratio of the region is smaller than the predetermined value, a color that can easily be easily identified is output. Thus, the possible lesion area that has the value smaller than the predetermined value can be distinguished from the normal image via the superimpose circuit 30 in accordance with this color.

[0033]
On the other hand, if the ratio of the image is greater than the predetermined value, two images captured with the wavelengths λ_1 and λ_2 are added. The result of the addition is transmitted to the superimpose circuit 30 so that the fluorescence image is superimposed so as to be positioned together with the normal image. Thus, the two images are displayed on the monitor 8.

[0034]
Of course, a similar display may be performed while displaying the region smaller than the predetermined value in a color that can easily be identified. Furthermore, a function may be provided which selectively displays the normal image and an image of either of the wavelengths or another function may be provided with which the fluorescence images of the two types of the wavelengths are displayed side by side.

[0035]
According to the apparatus of the first embodiment, by capturing the fluorescence image and the normal image by using the common CCD 18 and by passing the images through the two-dimensional lock-in amplifier 5, the S/N ratio of the fluorescence images can be greatly improved. Level imbalance between the fluorescence image signal and the normal image signal can be reduced, and problems of sticking, etc. can be eliminated and the two types of images can be displayed.

[0036]
Furthermore, since both the fluorescence image and the normal image can be captured by an apparatus with a simple structure, excellent orientation and the fluorescence observation with high sensitivity are provided, therefore, more accurate diagnosis and observation can be performed.

[0037]
an apparatus which to corresponds two images can be realized at low cost since the imaging part and the signal processing system are commonly used. In the first embodiment, the example was shown by the CCD 18, however, the solid-image detecting device such as CMD, SIT, MOS, etc can be utilized.

[0038]
Next a second embodiment of this invention will be explained. Fig. 4 through Fi. 8 relate to a second embodiment of the invention, Fig. 4 shows the structure of a fluorescence observation apparatus of the second embodiment, Fig. 5 explains the operations, Fig. 6 shows an example of a light source selection means, Fig. 7 shows other example of a light source selection means, and Fig. 8 shows a concrete example of a wavelength selection means. In this embodiment, the example of the number of integrating operation in correspondence with the bright ness of a fluorescence image and a normal image will be explained.

[0039]
The fluorescence image is extremely dark as compared with the normal image, the quantity of fluorescence is changed due to the difference in the excitation wavelength, that in the intensity of fluorescence, that between spontaneous fluorescence and fluorescence realized by a chemical and the type of the chemical. The apparatus of this embodiment is capable of satisfactorily displaying the two types of images even if the brightness of the fluorescence image is changed and the ratio of the brightness is changed with respect to that of the normal image.

[0040]
A fluorescence observation apparatus 40 according to this example comprises:
a laser 41 for emitting excitation light;
a lamp 42 for emitting normal light;
a light source selection means 43 for arbitrarily selecting excitation light or normal light;
an image detecting device 45 (for example, CCD, CMD, SIT) for irradiating a subject area to be observed 3 with each light to capture reflected light (normal light) or fluorescence light via an objective lens 44;
a wavelength selection means 46 for selecting the reflected light or the fluorescence light; a driver 47 for operating the image detecting device 45 at high speed, for example, from 30 to 2000 frames/sec;
a control circuit 48 for synchronously controlling the light source selection means 43, the wavelength selection means 46, and the driver 47;
an A/D converter 49 for converting data obtained by the image detecting device 45 into digital data;
an integrator 50 for integrating the digital data;

a multiplexer 53 for distributing a fluorescence image obtained due to the excitation light irradiation and a normal image to a first image memory 51 and a second image memory 52;
a superimpose circuit 54 for synthesizing images in the image memories 51 and 52; and
a monitor 55 for displaying the images.

[0041]
Initially, excitation light emitted by the laser 41 or normal light emitted by the lamp 42 is selected by the light source selection means 43 and the selected light is applied to a subject area 3 to be observed. Thus, fluorescence light or reflected light is generated in the diseased area 3a in the subject area 3 to be observed. The wavelength selection means 46, which is operated in synchronization with the light source selection means 43, selects, for example, a fluorescence image having the wavelengths λ_1 and λ_2 in Fig. 3 and a normal image from fluorescence light or reflected light. The selected images are formed on the image detecting device 45. Then, an electrical signal formed on the image detecting device 45 and photoelectrically converted is converted by the A/D converter 49. Then, the digital data is integrated by the integrator 50 in accordance with the brightness of the fluorescence and normal images. The fluorescence image is distributed to the first image memory 51, while the normal image is distributed to the second image memory 52 so as to be synthesized by the superimpose circuit 54 before the synthesized image is displayed on the monitor 55.

[0042]
Fig. 5 shows the timing of the example in Fig. 4. At this time, the image detecting device 45 is operated at high speed of, for example, 180 frames/sec. If the sensitivity of the fluorescence image with respect to the observed image is raised by 5 times, the rate of time in which laser is applied and time in which normal light (expressed with "Xe") is applied is made to be 5:1. Furthermore, the fluorescence images for five frames are integrated with respect to normal images for one frame to correspond to the ratio of time set as described above. Thus, the sensitivity of the fluorescence image can be improved. Symbol W in Fig. 5 represents an image formed by normal light.

[0043]
Fig. 6 illustrates an example of the wavelength selection means. As shown in Fig. 6, the surface of a rotatable plate 56 makes a predetermined angle from the optical axis to make the optical, axis of the laser 41 and that of the lamp 42 coincide with each other. The rotatable plate 56, as shown in Fig. 14 (b), comprises a transmission window 57 for permitting light to pass through and a reflecting mirror 58 for reflecting light, each of which is operated in synchronization with a projection portion 59 so that the angle of opening of the transmission window 57 is changed.

[0044]
That is, by moving the projection portion 59 by means of a groove 62 formed in a micro-stage 61 while rotating the rotatable plate 56 by a stepping motor 60 to change the angle of opening so as to change the quantity of opening of the transmission window 57, the ratio of excitation light to normal light can be changed. After the ratio has been set to an appropriate value, the groove 62 is retracted so that a state where the projection portion 59 cannot be introduced is realized.

[0045]
Fig. 7 illustrates another example of the wavelength selection means 43. Electronic shutters 63 and 64 are disposed in front of the laser 41 and the lamp 42. An inversion circuit 65 is added to the electronic shutters 63 and 64. When either the electronic shutter 63 or 64 is inversely controlled, light is alternately emitted. The light beams allowed to pass through the electronic shutter are introduced into the same optical path through a dichroic mirror 66.

[0046]
Fig. 8 illustrates a specific example of the wavelength selection means 46. As shown in Fig. 8 (a), the wavelength selection means 46 comprises a cult filter 67 for cutting excitation light, a polarizing plate 68, a TN cell 69, and a liquid crystal filter 71 incorporating a color polarizing plate.

[0047]
As shown in Fig. 8 (b), the liquid crystal filter 71 allows fluorescence light having the wavelength λ_1 or λ_2 that corresponds to the wavelength characteristic of the color polarizing plate which is turned on to pass through so as to introduce fluorescence light to the image detecting device 45 when the liquid crystal filter 71 is activated. When the liquid crystal filter 74 is deactivated, it allows light of all wavelength regions to pass through so as to introduce normal light into the image detecting device 45.

[0048]
As described above, according to the apparatus of the second embodiment, both fluorescence image and the normal image can satisfactorily be displayed even if the brightness of the fluorescence image is changed. Furthermore, the S/N ratio can be improved by

employing the two-dimensional lock-in amplifier in the first embodiment with the second embodiment.

[0049]
Fig. 9 illustrates a fluorescence observation endoscope apparatus 72 of a third embodiment that the first and the second examples have been applied to the endoscope. using this endoscope, the fluorescence in the body cavity can be observed. And the screening of a diseased area such as an initial-stage cancer is possible.
The same symbols are utilized for the same components as the first and second embodiments.

[0050]
The fluorescence observation endoscope apparatus 72 comprises; an endoscope 73 to be inserted into a body cavity; a light source apparatus 2; a two-dimensional lock-in amplifier 5; an image processing apparatus 6; a timing controller 7; and a monitor 8. The light guide 75 is inserted through the insertion portion 74 of the endoscope 73. The end portion is connected to the light source apparatus 2 so as to introduce illumination light from the light source apparatus 2.

[0051]
The light source apparatus 2 has the same structure as the first example shown in Fig. 1. Excitation light of a laser 9 is converted into pulse beams by a chopper 10, rotated by a motor 10a. The beams are reflected by a mirror 77a and the mirror surface of a rotatable mirror 77b on which mirror part and the transmission part (shown by the dashed line in Fig. 9) are provided and entered to the end of the light guide 75 adjacent to the hand of an operator. The rotation of the rotatable mirror 77b is controlled by the timing controller 7.

[0052]
Light emitted by the xenon lamp 11 is allowed to pass through a RGB rotatable filter 12 which is rotated by a motor 12a and arranged on the optical path, and is allowed to pass through a transmitting part (of the rotatable mirror 77b) at the timing when it reaches the optical path. Then, light is made incident on the light guide 75 at a position adjacent to the hand of the operator. Light made incident on the light guide 75 at a position adjacent to the hand of the operator is introduced into the body cavity into which an insertion portion 74 is inserted. Then, light is transmitted from the leading surface and is allowed to pass through an illumination lens 76 so that the subject portion to be observed is irradiated with light.

[0053]
A fluorescence image and a normal image generated due to light with which the subject portion to be observed has been irradiated are allowed to pass through a cover glass attached to an observation window formed at the leading portion of the endoscope, a polarizing plate 67, a first objective lens 44a, a liquid crystal filter 71 and a second objective lens 44b to be formed on the image detecting device 45 so as to be photoelectrically converted.

[0054]
The image detecting device 45 is operated in response to a drive signal supplied from a driver 47 so that an imaging signal photoelectrically converted by the image detecting device 45 is amplified by a pre-amplifier 79. Then, the amplified signal is supplied to an A/D converter 20, which constitutes a two-dimensional lock-in amplifier 5, and a video processor 6 provided in the image processing apparatus 81.

[0055]
The video processor 81 processes an imaging signal obtained due to the normal light irradiation such that it generates standard video data and causes a normal image to be displayed on the monitor 8 through a superimpose circuit 30.

[0056]
On the other hand, an imaging signal obtained due to fluorescence light irradiation is converted into a digital signal by the A/D converter 20, and then the converted signal is, through a multiplexer 28, distributed into frame memories 22a and 22b for storing odd frame images and even frame images. Then, image data is allowed to pass through a difference-calculating circuit 23 for calculating the difference between images and an integrating circuit 24 for integrating the output denoting the result of the calculation for obtaining the difference. Then, the image data is supplied to a multiplexer 28 in the image processing apparatus 6.

[0057]
Signals selected by the multiplexer 28 are temporarily stored in frame memories 22a and 22b. Two signals read from the frame memories 22a and 22b are calculated by a calculating circuit 23 so as to be signals corresponding to the discriminated state of the tissue. Then, the signals are converted into analog signals by a D/A converter 82, and then standard video data is made by a video processor 83, and video data is transmitted
to the superimpose circuit 30'.

[0058]

If a determination has been made that the subject portion to be observed is a diseased area, a fluorescence image is, in the form of a specific color signal, transmitted to the superimpose circuit 30'. While being superimposed, the fluorescence image is displayed or is subjected to a superimpose process to position the normal image and the fluorescence image side-by-side to simultaneously display the two images.
Note that a computer 31 controls the timing controller 7 and the superimpose circuit 30'.

[0059]
The fluorescence observation endoscope apparatus 72 enables a fluorescence image to be displayed in addition to the normal endoscope image. Furthermore, a region having a diseased tissue can be displayed in such a manner that it can be easily identified.

[0060]
Therefore, a significantly effective means to perform screening of a diseased portion, such as an initial-stage cancer, can be provided. The rotatable mirror 77b in Fig. 9 may be manufactured by plating or evaporating aluminum or the like, which is capable of serving as a mirror, onto the light-shielding portion of, for example, the rotatable shutter 13. Another structure may be employed in which a mirror is provided for a plunger and the plunger is operated at a predetermined period to introduce/remove the mirror to and from the optical path. The mirror may be reciprocated by a predetermined angular degree to introduce/remove the mirror to and from the optical path.

[0061]
Furthermore, a switch and the like may be provided so as to perform switching between a case in which excitation light and normal light are, by a mirror, sequentially introduced into the light guide 75 in a time-divided manner and a case in which either light is selectively manually introduced to enable the fluorescence light observation to be performed if necessary. The other operations and effects are the same as those of the foregoing embodiments.

[0062]
Fig. 10 and Fig. 11 illustrate an example of use of the fluorescence endoscope apparatus in which a portion of the intestinum crassum, from which sigmoid colon has been exsected, is inosculated. It is important to know the metabolism in the inosculated portion for the purpose of preventing a failure in suture. NADH contained in a texture of an organism is a substance that causes oxygen metabolism to be performed. By observing fluorescence light of NADH, a state of metabolism in the suture portion can be diagnosed. FIGS.10 and 11 illustrate an example for measuring NADH to achieve the foregoing object.

[0063]
Referring to FIG. 10, the example will now be described. A fluorescence endoscope system 101 comprises an endoscope 102, a light source apparatus 103, a signal processing apparatus 104 and a monitor 105.

[0064]
The light source apparatus 103 includes a white light source 107 that has an irradiation optical path on which a band-pass filter 108 through which light for excitation NADH is allowed to pass through is provided, the band-pass filter 108 being enabled to be retracted when, for example, a motor 109 is rotated. A condenser lens 110 is provided in front of the band-pass filter 108 to supply normal light to an end surface of a light guide 111 to be attached to the light source apparatus 103 at a position adjacent to the hand of an operator.

[065]
A light guide 111 provided for the endoscope 102 is inserted into a soft insertion portion 112 to transmit white light or excitation light which is emitted forwards through the leading surface of the light guide 111 attached to an illumination window at the leading portion of the insertion portion 112. Thus, for example, a suture portion 114 of the intestinum crassum 113 is irradiated with light.

[0066]
Reflected white light or fluorescence light is, by an objective lens 115 attached to the observation window at the leading portion, imaged on the leading surface of an image guide 116 arranged on the focal point surface. The image guide 116 transmits a fluorescence image or a reflected light image to the rear end surface of the image guide 116 at a position adjacent to the hand of the operator.

[0067]
A cut filter 117 for cutting excitation light, an imaging lens 118 and a CCD 119 are sequentially arranged at positions facing the rear end surface of the image guide 116. A signal photoelectrically converted by the CCD 119 is supplied to a CCU 120 in the signal processing circuit 104 so as to be converted into video data. The CCU 120 has a function of the two-dimensional lock-in amplifiers 5 shown in FIG 9.

[0068]
The signal processing circuit 104 comprises the CCU 120, a memory 121 for storing video data transmitted by the CCU 120, a fluorescence image and a normal image, a timing controller 122 for transmitting a timing control signal for controlling opening/closing of the band-pass filter 108 which separates the fluorescence image and the normal image to be supplied to the memory 121, and a superimpose circuit 123 for synthesizing the two images.

[0069]
Since the operation of the fluorescence endoscope system 101 is the same as the fluorescence endoscope apparatus according to the foregoing embodiments, its description is omitted. Its effect is also similar to the embodiments above and the fluorescence endoscope system 101 can be similarly applied to a hard endoscope as well as to the soft endoscope.

[0070]
The fluorescence endoscope system 131 shown in FIG. 11 will now be described. This example is intended not to obtain a fluorescence image but has an arrangement that an optical probe inserted into a channel of an endoscope and arranged to introduce light is brought into contact with a suture portion to measure the metabolism of the contact portion by means of fluorescence light of NADH.

[0071]
The endoscope system 131 comprises an endoscope 132, a light source apparatus 133 for supplying to the endoscope 132, white illumination light, a light-introducing probe 135 inserted into a channel 134 of the endoscope 132, a second light source apparatus 103 for supplying excitation light to the light-introducing probe 135, a detection apparatus 136 for detecting fluorescence light introduced through the light-introducing probe 135, an analyzing apparatus 137 for obtaining metabolism from fluorescence light detected by the analyzing apparatus 136, and a display apparatus 138 for displaying the result of the analysis.

[0072]
The endoscope 132 has an elongated and soft insertion portion 141 into which a light guide 142 is inserted. An end of the light guide 142 adjacent to the hand of an operator is connected to the light source apparatus 133 so that white light emitted by a white light source 143 is supplied through a condenser lens 144. White light is emitted forwards through an illumination window formed at the leading portion of the insertion portion 141 so that, for example, a suture portion 114 of the intestinum crassum 113 is irradiated with light.

[0073]
Light reflected by the suture portion 114 is, by the objective lens 115 attached to the observation window, imaged on the leading surface of the image guide 116 provided on the focal point surface of the objective lens 115. Light is transmitted through the image guide 116 to the rear end surface of the same so that the suture portion 114 can be observed with the naked eye through an ocular lens 146.

[0074]
The portion of the light-introducing probe 135 inserted into the channel 134 of the endoscope 132 adjacent to the hand of the operator is divided into two pieces, either of which is connected to the light source apparatus 103 and a residual one of which is connected to the detection apparatus 136.

[0075]
The light source apparatus 103 has the same structure as that shown in FIG. 10 to introduce excitation light so as to emit excitation light through a leading surface projecting over an outlet at the leading portion of the channel 134 toward the suture portion 114 which is in contact with the leading surface. Excitation light obtained from the suture portion 114 is introduced into the portion adjacent to the hand of the operator by the light-introducing probe 135, and is detected by a detector 147 through the cut filter 117 for cutting excitation light. The quantity of detected excitation light is analyzed by the analyzing apparatus 137 and the result of the analysis is displayed on the display apparatus 138.

[0076]
Near infrared light may be used to measure cytochrome or to measure the bloodstream by a laser Doppler meter as well as NADH to obtain the metabolism. Note that the foregoing embodiments may partially be combined with each other to constitute another embodiment.

[0077]
[Effect of the Invention]
As described above, according to this invention, normal illumination light and excitation light are irradiated to an area to be observed in a time-divided manner, and an observation image by the illumination light and a fluorescence image by the excitation light are selected by the selection means. The selected image (either the observation image or the fluorescence image) is captured by a common image detecting means in synchronization with the

timing of irradiation. Thus, a fluorescence image and a normal image can be captured by the common image detecting means. Since the processes such as differential calculation process are applied at least to the fluorescence image of the images captured by this image detecting means by the image processing means, level imbalance between the fluorescence image signal and the normal image signal can be reduced since the S/N ratio of the fluorescence image is greatly improved by the image processing means. Thereby, problems of halation, etc. can be prevented.

[Brief Description of Drawings]
[Fig. 1]
Fig. 1 is an overall schematic diagram of a fluorescence observation apparatus of a first embodiment.

[Fig. 2]
Fig. 2 is a characteristic diagram showing one example of the distribution of florescence intensities of a normal area and a diseased area.

[Fig. 3]
Fig. 3 is a timing chart explaining the operation of the first embodiment.

[Fig. 4]
Fig. 4 is an overall schematic diagram of a fluorescence observation apparatus of a second embodiment of this invention.

[Fig. 5]
Fig. 5 is an explanatory drawing of the operation of the second embodiment.

[Fig. 6]
Fig. 6 is an explanatory drawing showing one example of light source selection means.

[Fig. 7]
Fig. 7 is an explanatory drawing showing another example of light source selection means.

[Fig. 8]
Fig. 8 is an explanatory drawing showing a concrete example of wavelength selection means.

[Fig. 9]
Fig. 9 is a schematic diagram of a fluorescence endoscope apparatus of a third embodiment of this invention.

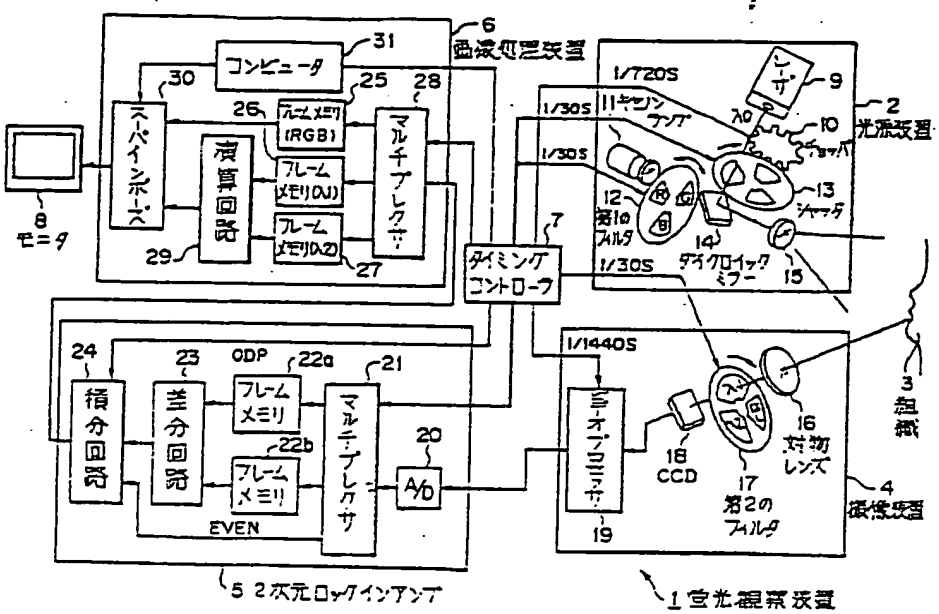
[Fig. 10]
Fig. 10 is a schematic diagram of an endoscope system suitable for a diagnosis of the condition of metabolism in suture area.

[Fig. 11]
Fig. 11 is a schematic diagram of a modified example of Fig. 10.

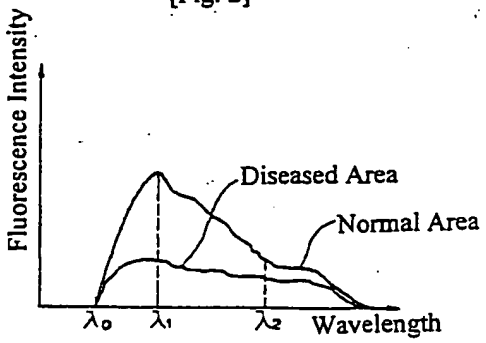
[Fig. 12]
Fig. 12 is an overall schematic diagram of a conventional florescence observation apparatus.

[Explanation of Symbols]
1...a fluorescence observation apparatus
2...a light source apparatus
3...tissue
4...an image detecting apparatus
5...a two-dimensional lock-in amplifier
6...an image processor
7...a timing controller
8...a monitor
9...a laser
10...a chopper
11...a xenon lamp
12...a first filter
13...a rotatable shutter
14...a dichroic mirror
15...an objective lens
17...a second filter
18...a CCD
19...a video processor
21...a multiplexer
22a, 22b...frame memories
23...a differential circuit
24...an integration circuit
26, 27...frame memories
29...a calculation circuit
30...a superimpose circuit

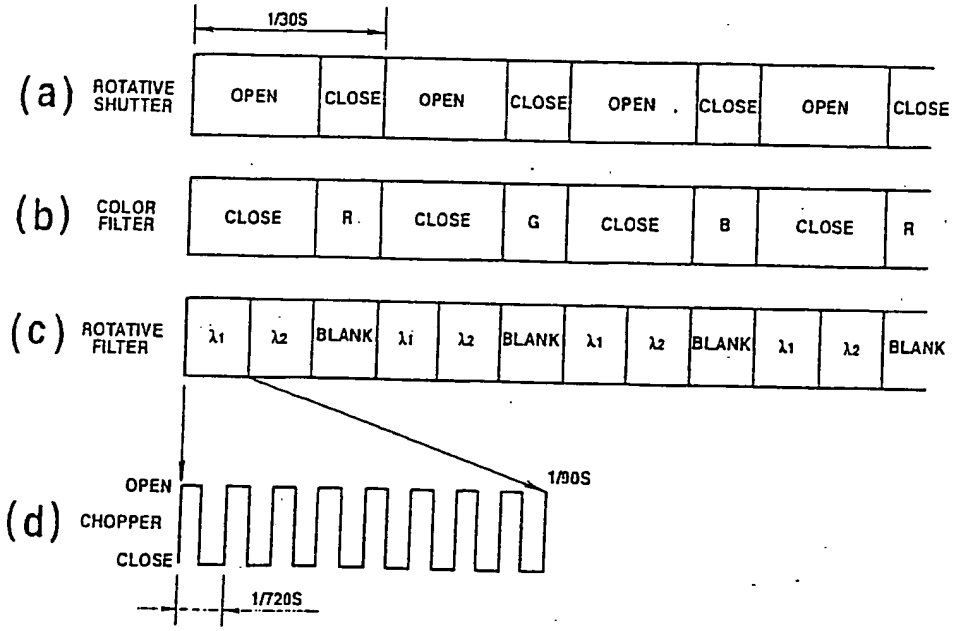
[Fig. 1]



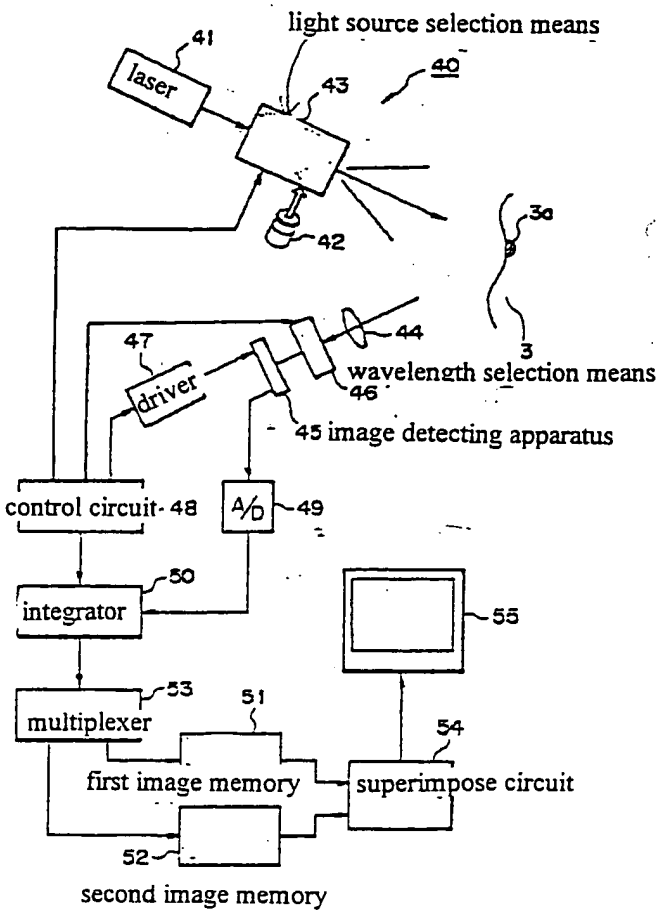
[Fig. 2]



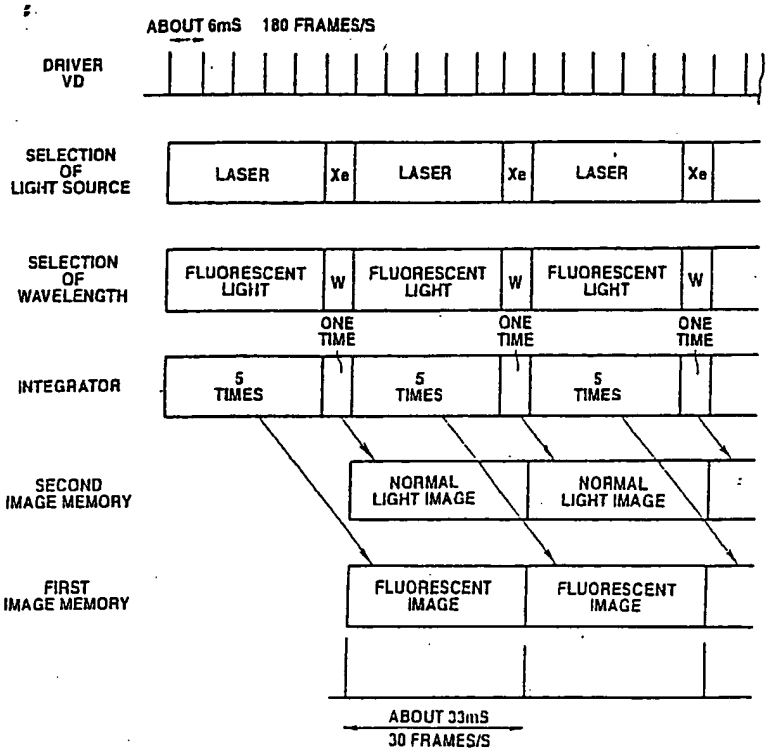
[Fig. 3]



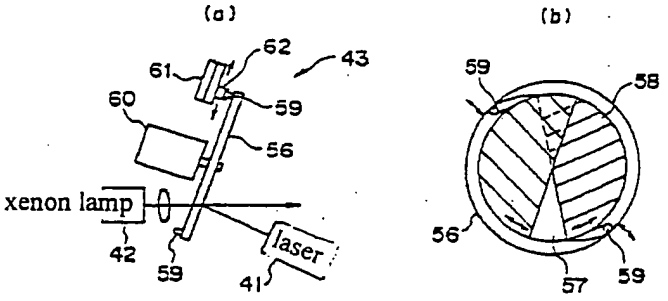
[Fig. 4]



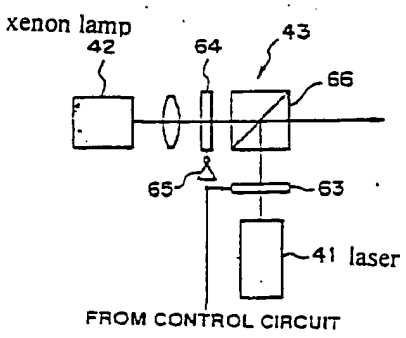
[Fig. 5]



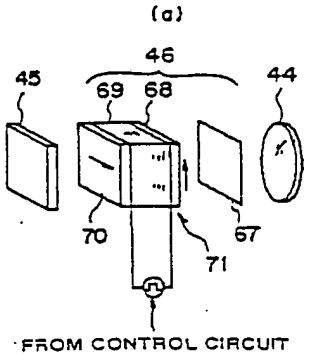
[Fig. 6]



[Fig. 7]



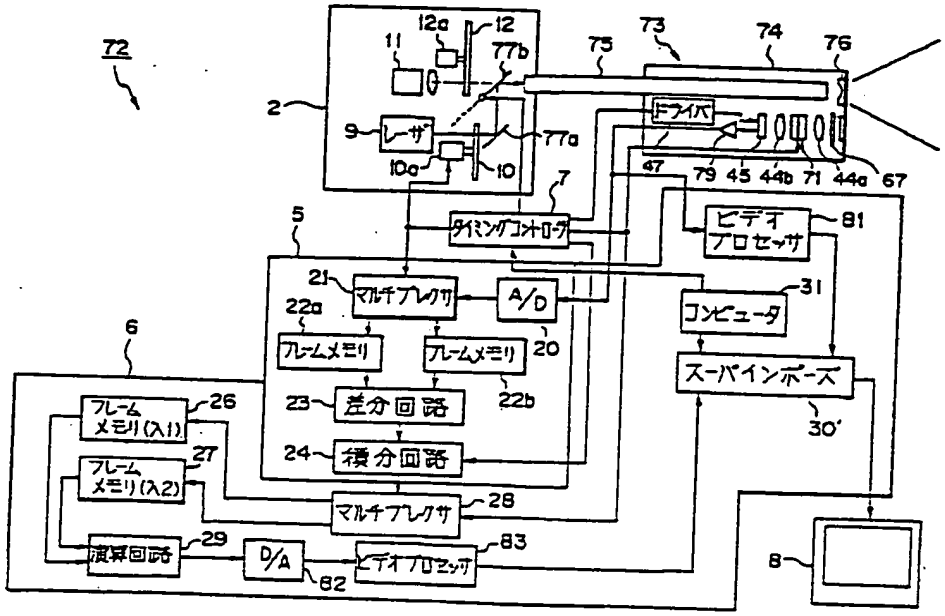
[Fig. 8]



(b)

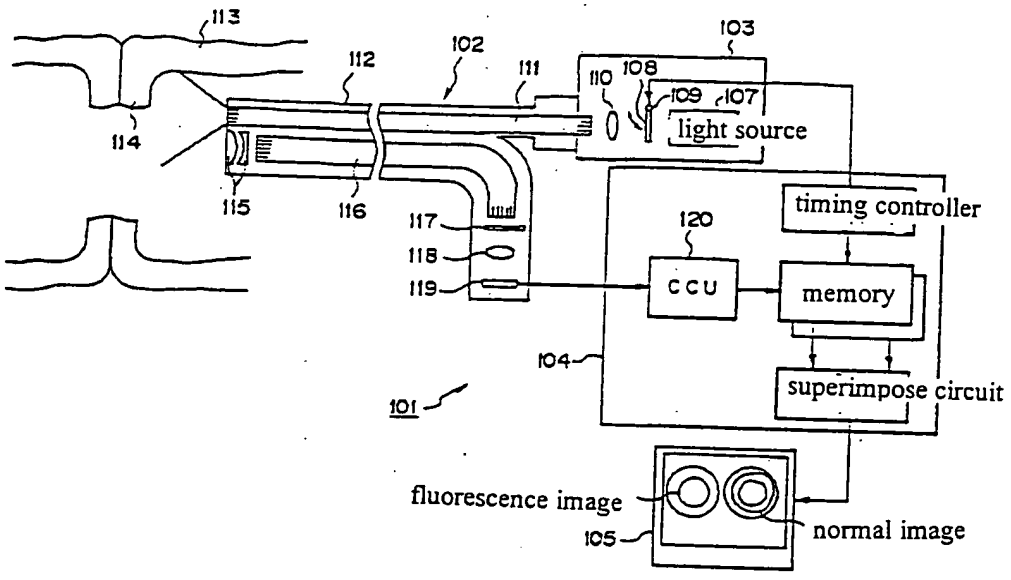
ON	FLUORESCENT IMAGE
OFF	NORMAL LIGHT IMAGE

[Fig. 9]

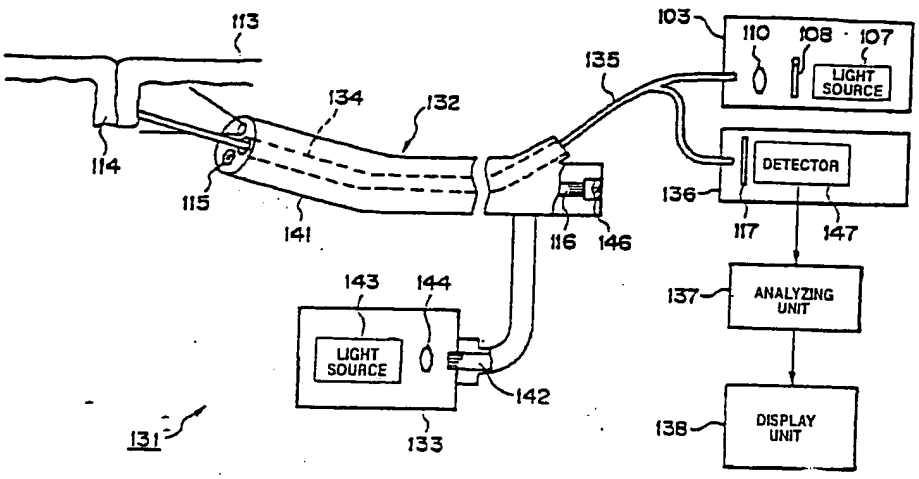


7...timing controller
9...laser
21...multiplexer
22a, 22b...frame memory
23...differential circuit
24...integration circuit
26...frame memory (λ_1)
27...frame memory (λ_2)
29...calculation circuit
30...superimpose circuit
47...driver
31...computer
81, 83...video processor

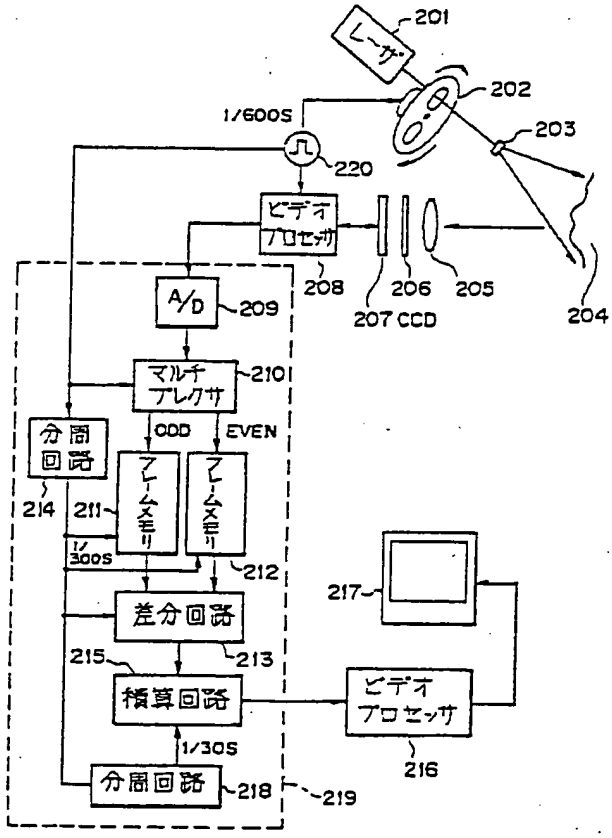
[Fig. 10]



[Fig. 11]



[Fig. 12]



201...laser
208...video processor
210....multiplexer
211, 212...frame memory
213...differential circuit
214, 218...division circuit
215...integration circuit
216...video processor

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MACHINE-ASSISTED TRANSLATION (MAT):

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【全頁数】 １１	**[NUMBER OF PAGES]** 11
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(57)【要約】	**(57)[SUMMARY]**

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【目的】
共通の撮像素子で蛍光画像と通常観察像とを焼き付けなどが発生するなく撮像できる蛍光観察装置を提供すること。

【構成】
レーザ９で発生した励起用光とキセノンランプ１１で発生した照明光とを、タイミングコントローラ７でタイミング制御される第１のフィルタ１２及び回転シャッタ１３等で時分割で組織３側に照射し、対物レンズ１６及び第１のフィルタ１２等と同期して回転する第２のフィルタ１７とを経て共通のＣＣＤ１８で蛍光画像と通常画像とが時分割で撮像され、２次元ロックインアンプ５を通すことにより、特に蛍光画像のＳ／Ｎが大幅に向上され、通常画像との信号レベルのアンバランスが縮小された後、焼き付け等が発生することなく、両画像をモニタ８に表示できるようにした。

[OBJECT]
Provide the fluorescent observation apparatus which can record without burning etc. generating for fluorescent and usual observation images with a shared image-pick-up element.

[SUMMARY OF THE INVENTION]
A light for excitation generated by the laser 9 and the illumination light generated by the xenon lamp 11 are irradiated to a tissue 3 side in time slices with the first filter 12, the rotation shutter 13, etc. by which timing control is carried out by the timing controller 7.
A fluorescent and usual image are recorded in time slices by shared CCD18 through the 2nd filter 17 rotated synchronizing with the objective lens 16, the first filter 12, etc.
By passing through the two-dimensional lock-in amp 5, especially S/N of a fluorescent image improves sharply.

burning etc. does not occur, after reducing imbalance of the signal level with a usual image, and it enabled it to display both images to a monitor 8.

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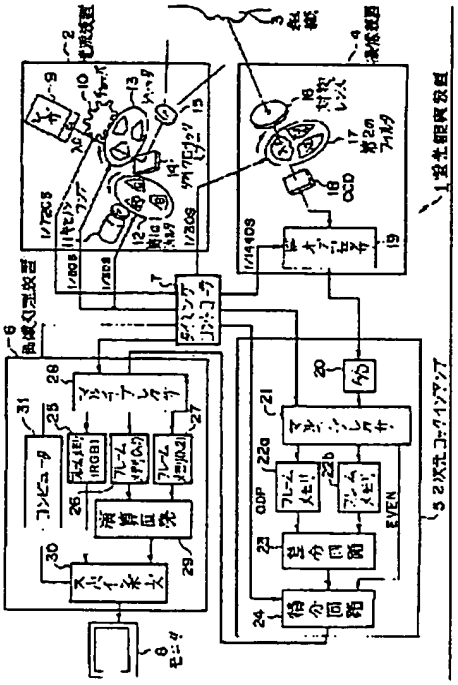

[translation of Japanese text in Selection Diagram]
also refer to EXPLANATION OF DRAWINGS
25 frame memory (RGB)
28 multiplexer

【特許請求の範囲】 **[CLAIMS]**

【請求項１】
通常の照明光による観察像と、励起光による励起に基づく蛍光像の両方を同時あるいは、時分割で切換えて表示できる蛍光観察装置において、
前記照明光と励起光を時分割で照射する光照射手段と、
前記照明光又は励起光が照射される対象物側からの反射光或は蛍光による観察像又は蛍光像のいずれかを、選択する選択手段

[CLAIM 1]
A fluorescent observation apparatus.
In the fluorescent observation apparatus which can switch and display both observation images by the usual illumination light, and fluorescent image based on the excitation by excitation light simultaneously or in time slices, optical irradiation means to irradiate the above-mentioned illumination light and above-mentioned excitation light in time slices,
Choice means to choose between either the observation image by the reflected light or the

と、
前記選択手段で選択された像を、前記光照射手段と同期して撮像する撮像手段と、
前記撮像手段により撮像した画像を差分あるいは積分あるいはその両方を行う画像処理手段と、
前記光照射手段と選択手段と、撮像手段及び画像処理手段を同期制御する制御手段と、
を有することを特徴とする蛍光観察装置。

fluorescence from the target-object side by which the above-mentioned illumination light or above-mentioned excitation light is irradiated, or the fluorescent images, , image-pick-up means to image-pick up the image chosen with above-mentioned choice means synchronizing with above-mentioned optical irradiation means, image-processing means to calculate the difference, integral, or both, for the image recorded by the above-mentioned image-pick-up means, the above-mentioned optical irradiation means, choice means, and control means which carries out synchronous control of image-pick-up means and image-processing means, it has these components.

【発明の詳細な説明】

[DETAILED DESCRIPTION OF INVENTION]

【０００１】

[0001]

【産業上の利用分野】
本発明は通常の照明光による観察像と、励起光による蛍光像とを得ることのできる蛍光観察装置に関する。

[INDUSTRIAL APPLICATION]
This invention relates to the fluorescent observation apparatus which can obtain the observation image by the usual illumination light, and the fluorescent image by excitation light.

【０００２】

[0002]

【従来の技術】
近年、生体からの自家蛍光や、生体へ薬物を注入し、その薬物の蛍光を２次元画像として検出

[PRIOR ART]
In recent years, from the self-fluorescence from the organism, or medicine is injected into the organism, and it is detected, using the

し、その蛍光像から、生体組織の変性や癌等の疾患状態（例えば、疾患の種類や浸潤範囲）を診断する技術がある。

fluorescence of the medicine as a two-dimensional image.

From the fluorescent image, there is a technique that illness states (for example, the kind and permeation extent of the illness), such as the modification of an organism tissue and cancer, are diagnosed.

【０００３】

生体組織に光を照射するとその光（励起光）より長い波長の蛍光が発生する。生体における蛍光物質として、例えばＮＡＤＨ（ニコチンアミドアデニンヌクレオチド），ＦＭＮ（フラビンモノヌクレオチド），ピリジンヌクレオチド等がある。最近では、このような、生体内因物質と、疾患との相互関係が明確になってきた。また、ＨｐＤ（ヘマトポルフィリン），Ｐｈｏｔｏｆｒｉｎ，ＡＬＡ（δ－ａｍｉｎｏ　ｌｅｖｕｌｉｎｉｃ　ａｃｉｄ）は、癌への集積性があり、これを生体内に注入し、前記物質の蛍光を観察することで疾患部位の診断に利用される。

[0003]

If a light is irradiated to an organism tissue, the fluorescence of a wavelength longer than the light (excitation light) will occur.

It uses as the fluorescent material in the organism, for example, there are NADH (nicotinamide adenine nucleotide), FMN (flavin mononucleotide), pyridine nucleotide, etc.

Recently, the interactive relationship with the illness and such in-the-living-body ?factor-substance? becomes clear.

Moreover, HpD (hematoporphyrin) and Photofrin, ALA((delta)-amino levulinic acid) have the accumulation property towards cancer.

This is injected in the living body, and it is utilized for a diagnosis of an illness site by observing the fluorescence of the above-mentioned matter.

【０００４】

ところで、上記の蛍光は、極めて微弱であるので、その観察のためには、極めて高感度の撮影を必要とする。この高感度撮影を行うものとしてイメージ・インテンシファイヤが良く知られ

[0004]

By the way, since the above-mentioned fluorescence is very slight, it needs photography of a high sensitivity extremely for the observation, and the image * intensifier is well known as that which performs this high-sensitivity photography.

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ている。また、最近では図１２に示すように２次元で同期検波を行い、感度を高める方法が提案されている。

Moreover, as shown in Diagram 12, recently, two-dimensionally synchronous detection is performed, and the process of raising a sensitivity is proposed.

【０００５】
まず、レーザ装置２０１より連続的なレーザ光を照射し、これを、チョッパ２０２によりクロック発生器２２０で発生した１／６００Ｓのクロックを高速度でチョッピングし、凹レンズ２０３で拡大し、組織２０４に照射する。この組織２０４からの蛍光をレンズ２０５，フィルタ２０６を通じ、ＣＣＤ２０７で撮像する。

[0005]
First, a laser light continuously from the laser apparatus 201 is irradiated.
The chopping of the clock of 1/600S which generated this by the clock generator 220 by the chopper 202 is carried out at high speed.
It enlarges with a concave lens 203, and it irradiates to the tissue 204.
A lens 205 and the filter 206 are passed in the fluorescence from this tissue 204, and it records by CCD207.

【０００６】
フィルタ２０６はレーザ光をカットし、それより長い波長、つまり蛍光のみを通過させるバンドパスフィルタである。この時、蛍光は励起光の明滅と同期し、発生し、これをＣＣＤ２０７で前記チョッピング、つまり１／６００Ｓの周期と同期して検出する。そして、これをビデオプロセッサ２０８で画像信号とし、さらにＡ／Ｄコンバータ２０９によりデジタルデータに変換する。

[0006]
A filter 206 cuts the laser light.
It is the band-pass filter which passes longer wavelengths, in other words fluorescent only.
At this time, a fluorescence synchronizes with the blinking of excitation light, it generates, and this is detected by CCD207 synchronizing with the period of the above-mentioned chopping and in other words 1/600S.
And, let this be an image signal by the video processor 208.
Furthermore conversion is carried out to digital data by A / D converter 209.

【０００７】
このデータを前記クロック１／６００Ｓのタミングでマルチプ

[0007]
A multiplexer 210 is switched for this data at the timing of the above-mentioned clocks 1/600S.

レクサ２１０を切り換え、ＯＤＤとＥＶＥＮのフレーム、つまり蛍光が発生している時と、発生していない時の画像（又は逆でもよい）に分け各々フレームメモリ２１１，２１２に記憶される。このフレームメモリ２１１，２１２記憶されたデータを１／３００Ｓ（分周回路２１４によりクロックが分周した。）の周期で差分回路２１３により差分するとともに、さらに、これを例えば１０回程度、積算回路２１５により積算することでノイズをキャンセルし、必要な信号を増幅し結果的にＳ／Ｎを向上できる。

It divides into the frame of ODD and EVEN, the time of in other words the fluorescence having occurred, and the image (or the contrary) when not having generated, and each frame memories 211 and 212 store it.
While carrying out the difference of this frame memory 211 and the data stored 212 times by the differential circuit 213 with the period of 1/300S (the clock divided by the divider circuit 214), furthermore, the noise is cancelled by carrying out integrating of this by the counting circuit 215 about 10 times, for example.

The required signal is amplified and S/N can be improved as a result.

【０００８】
これをビデオプロセッサ２１６でビデオ信号としてモニタ２１７に表示する。尚、図中２１９はＳ／Ｎを向上させるための２次元ロックインアンプ部を示している。

[0008]
This is displayed on the monitor 217 as a video signal by the video processor 216.

In addition, 219 shows the two-dimensional lock-in amp part for raising S/N in the drawing(s).

【０００９】
一方、蛍光観察においては、蛍光像の他、通常の画面の観察も、オリエンテーション等を行う上で重要である。従来では、蛍光像と通常像の両方を撮影するため、複数のカメラを使用したり、又、同一のカメラを時分割で撮影していた。

[0009]
On the one hand, in fluorescent observation, besides fluorescent images, the observation of a usual screen is also important when performing orientation etc.

Some cameras are used, in order to take a photograph of both fluorescent image and usual image, conventionally.

Moreover, a photograph with the same camera is taken in time slices.

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【００１０】

【発明が解決しようとする課題】
蛍光像と通常像を異なるカメラで撮影した場合、構造が複雑になったり撮像部分が大型になったりしていた。又、一つのカメラで時分割で撮影した場合、蛍光と通常画像の受光強度が極めて異なるため、蛍光像が暗くなったり通常像がハレーションが起きたり、最悪時には焼き付けが起こる問題があった。

【００１１】

本発明は上述した点にかんがみてなされたもので、一つのカメラで焼き付け等が発生することがなく、かつ簡単な構造で蛍光像と通常像の両方を良好に撮影することのできる蛍光観察装置を提供することを目的とする。

【００１２】

【課題を解決するための手段および作用】
通常照明光と励起光を時分割で照射する光照射手段と、対象物に照射された照明光又は励起光による観察像又は蛍光像を選択

[0010]

[PROBLEM ADDRESSED]

In the case of photographing with the camera which differs a fluorescent and usual image, the structure became complicated or the image-pick-up part was large-sized.

Moreover, since light-receiving strength of a fluorescence and a usual image differs extremely in time slices with one camera in a photographed case, the fluorescent image becomes dark, and halation occurs in the usual image.

Moreover, there was the problem that burning happens, in the worst cases.

[0011]

This invention was made in view of the above-mentioned end. burning etc. does not occur with one camera. And it aims at providing the fluorescent observation apparatus which can take satisfactorily a photograph of both fluorescent image and usual image with the simple structure.

[0012]

[SOLUTION OF THE INVENTION and EFFECTS]

The image chosen with the optical irradiation means which irradiates usual and excitation light in time slices, choice means to choose the observation image by the illumination light or

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する選択手段と、この選択手段で選択された画像を、前記光照射手段と同期させて、観察像又は蛍光像を撮像する撮像手段と、前記撮像手段により撮像した画像を、差分あるいは積分あるいはその両方を行う画像処理手段と、前記光照射手段と選択手段と、撮像手段及び画像処理手段を同期制御する制御手段とを設けることにより、一つのカメラで撮像可能にするとともに、画像処理手段により蛍光像のS／Nを向上し、且つハレーションの発生を防止できるようにしている。

the excitation light irradiated by the target object or a fluorescent image, and this choice means is synchronized with the above-mentioned optical irradiation means.

Image-pick-up means to image-pick up an observation image or a fluorescent image, image-processing means to perform the image recorded by the above-mentioned image-pick-up means a difference, integral, or both, above-mentioned optical irradiation means and choice means, and control means which carries out synchronous control of image-pick-up means and image-processing means. These are provided, while making an image pick-up possible with one camera, S/N of the fluorescent image is improved by image-processing means, and it enables it to prevent generating of halation.

【００１３】

[0013]

【実施例】

以下、図面を参照して本発明の実施例を説明する。図１ないし図３は本発明の第１実施例に係り、図１は第１実施例の蛍光観察装置の構成を示し、図２は正常部と病変部の場合における蛍光強度分布の１例を示し、図３は第１実施例の動作説明用のタイミングチャートを示す。この第１実施例は蛍光像と観察像の両方を共通の撮像素子で時分割で検出する装置である。

[Embodiment]

Hereafter, the embodiment of this invention is demonstrated with reference to drawings.

Fig. 1 or 3 concerns the 1st embodiment of this invention.

Diagram 1 shows the composition of the fluorescent observation apparatus of the 1st embodiment.

Diagram 2 shows 1 example of the fluorescence-intensity distribution in the case of a normal part and a disease part.

Diagram 3 shows the timing chart for description of the 1st embodiment of operation.

This 1st embodiment is an apparatus which

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detects both fluorescent image and observation image in time slices with a shared image-pick-up element.

【００１４】
図１に示す第１実施例の蛍光観察装置１は通常の観察のための照明光と蛍光観察のための励起光とを発生する光源装置２と、観察対象被写体となる組織３の通常像と蛍光像を撮像する撮像装置４と、この撮像装置４で検出した画像を増幅し、Ｓ／Ｎを向上させる２次元ロックインアンプ５と、前記画像を通常像と蛍光像に分け、各々処理するとともに、各画像を合成する画像処理装置６と、前記光源装置２と撮像装置４と２次元ロックインアンプ５と画像処理装置６とを同期制御するタイミングコントローラ７と、前記画像処理装置６を経た画像を表示するモニタ８より構成される。

[0014]
For the fluorescent observation apparatus 1 of the 1st embodiment shown in Diagram 1, the light source device 2 which generates the illumination light for a usual observation, and the excitation light for fluorescent observation, the image-pick-up apparatus 4 which records the usual image and the usual fluorescent image of the tissue 3 which serves as the photographed object for observation, the two-dimensional lock-in amp 5 which amplifies the image detected with this image-pick-up apparatus 4, and raises S/N, while the above-mentioned image is divided into a usual image and a usual fluorescent image and processing respectively

The image processing device 6 which synthesises each image, the timing controller 7 which carries out synchronous control of the above-mentioned light source device 2, the image-pick-up apparatus 4, the two-dimensional lock-in amp 5, and the image processing device 6, It consists of the monitor 8 which displays the image which passed through the above-mentioned image processing device 6.

【００１５】
前記光源装置２は、波長がλ０（例えばλ０＝３５０ｍｍ～５００ｍｍ）の励起光（簡単化のため励起光λ０と略記する）を

[0015]
The above-mentioned light source device 2, a wavelength is (lambda)0 (for example, (lambda)0=350 mm - 500 mm) excitation light). (abbreviated as excitation-light (lambda)0 for

発生させるレーザ９（例えばエキシマレーザ、クリプトンレーザ、Ｈｅ－Ｃｄレーザ、色素レーザを用いることができる。）と、前記レーザ光の光路上に周縁部分がかかるように配置され、１／７２０Ｓの周期で明滅させるように遮光円板の周縁に凹凸を設け、回転駆動されるチョッパ１０と、通常画像を観察するための照明光を発生するキセノンランプ１１と、この照明光の光路上に配置され、Ｒ，Ｂ，Ｇの色フィルタを持ち、図示しないモータで例えば１／３０Ｓで回転される第１の回転フィルタ１２と、この第１の回転フィルタ１２と同期して、レーザ光の光路上に配置され、このレーザ光を透過及び遮光する（１／３０Ｓで回転される）回転シャッタ１３と、照明光の光路上に４５° 傾けて配置され、かつレーザ光の光路上になる位置に配置され、励起光λ０ のみを反射するダイクロイックミラー１４と、このダイクロイックミラー１４の前方の光路上に配置され、拡開して組織３側に光を照射するための照明レンズ１５とより成る。つまり、光源装置２はパルス化された励起光としてのレーザ光と、Ｒ，Ｇ，Ｂ照明光を交互に照射する。

simplification)
The laser 9 was made to generate this.
(For example, an excimer laser, a krypton laser, a He-Cd laser, and a dye laser can be used)
It is configured so that the circumference part may hit the optical path of the above-mentioned laser light.

Roughness is provided on the circumference of the shading disc so that a blinking may be carried out with the period of 1/720S.
This illumination light is configured in the optical path with the chopper 10 by which it rotates, and the xenon lamp 11 which generates the illumination light for observing a usual image.
It has the colour filter of R, B, and G.
It synchronizes with the first rotating filter 12 rotated, for example, by 1/30S by the motor not illustrated, and this first rotating filter 12.
A laser light is configured in the optical path.
The rotation (it rotates by 1/30S) shutter 13 which permeates and shades this laser light, and an illumination light leaning 45-degrees in the optical path, and it is configured.
And it is situated on the position which a laser light is in the optical path.
The dichroic mirror 14 which reflects only excitation-light (lambda)0, the front of this dichroic mirror 14 is configured in the optical path.

It consists of the illumination lens 15 for expanding and irradiating a light to a tissue 3 side.

In other words, light source device 2 irradiates laser light pulse -ized excitation light, and r, G, and B illumination light alternately.

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【００１６】
前記撮像装置４は組織３の光学像を結ぶための対物レンズ１６と、この対物レンズ１６の光路上に配置され、前記第１のフィルタ１２，回転シャッタ１３と同期するように図示しないモータで１／３０Ｓで回転され、蛍光画像（λ０より長波長のλ１，λ２の蛍光）と、通常画像を通過させる第２のフィルタ１７と、前記蛍光及び通常画像を共用で時分割で撮影するための撮像素子としてのＣＣＤ１８と、このＣＣＤ１８を駆動するとともに画像信号に変換するビデオプロセッサ１９とより成る。

[0016]
For the above-mentioned image-pick-up apparatus 4, objective lens 16 which focuses the optical image of tissue 3 , this objective lens 16 is configured in the optical path.
It rotates by 1/30S by the motor not displayed so that it may synchronize with the first filter 12 and the rotation shutter 13.
The fluorescent image, ((lambda)1, (lambda)2 fluorescence with longer wavelength than ((lambda)0), the 2nd filter 17 which passes a usual image, cCD18 as an image-pick-up element for taking a photograph of the above-mentioned fluorescence and the above-mentioned usual image in time slices shared, and the video processor 19 which carries out conversion to an image signal while actuating this CCD18.
It consists of these.

【００１７】
尚、ビデオプロセッサ１９，第２のフィルタ１７はタイミングコントローラ７で制御され、ビデオプロセッサ１９は例えば１／７２０Ｓの１／２の１／１４４０Ｓの高速な周期でそれぞれ１フレームの画像信号を生成する。

[0017]
In addition, the video processor 19 and the 2nd filter 17 are controlled by the timing controller 7.
The video processor 19 respectively forms the image signal of one frame during the high-speed period of 1/2 of 1/1440S, or 1/720S, for example.

【００１８】
２次元ロックインアンプ５は前記画像信号をデジタルデータに変換するＡ／Ｄ変換器２０と前記タイミングコントローラ７と同期し、レーザ９の励起光の明

[0018]
The two-dimensional lock-in amp 5 synchronizes with A/D converter 20 which carries out conversion of the above-mentioned image signal to digital data, and the above-mentioned timing controller 7.

滅に合わせ、それぞれの画像データをフレームごとにフレームメモリ（ＯＤＤ）２２ａとフレームメモリ（ＥＶＥＮ）２２ｂに分けるマルチプレクサ２１と、フレームメモリ（ＯＤＤ）２２ａとフレームメモリ（ＥＶＥＮ）２２ｂを差分し、ノイズ分をキャンセルしてＳ／Ｎを大幅に向上する差分回路２３と、ノイズ分をキャンセルされた画像を累積するように積分（同じ画像部分同士をそれぞれ累積するように積分）することによりＳ／Ｎを上げて増幅する積分回路２４とから成る。尚、通常光の場合はフレームメモリ及び差分回路を経由せず直接、積分回路２４に入力される。

Matching the blinking of the excitation light of laser 9, the multiplexer 21 which divides each image data into frame-memory (ODD) 22a and frame-memory (EVEN) 22b for every frame, the difference of frame-memory (ODD) 22a and the frame-memory (EVEN) 22b is calculated.

The differential circuit 23 which cancels a part for a noise and improves S/N sharply, the integration circuit 24 which raises and amplifies S/N by integrating so that the image cancelled in a part for a noise may be accumulated (it is integrating so that the same image parts may respectively be accumulated) It consists of these.

In addition, in the case of ordinary light, not passing through a frame memory and a differential circuit, it is directly input into an integration circuit 24.

【００１９】

また、画像処理装置６は前記増幅された通常及び蛍光画像データをタイミングコントローラ７と同期して、通常画像記憶用フレームメモリ（ＲＧＢのフレームメモリからなる）２５，λ１画像記憶用フレームメモリ２６，λ２画像記憶用フレームメモリ２７へ分離するマルチプレクサ２８と、蛍光画像から組織の性状を明確にするためλ１画像記憶用フレームメモリ２６及びλ２画像記憶用フレームメモリ２７を演算回路２９と、通常画像記憶用フレームメモリ２６

[0019]

Moreover, concerning the image processing device 6, for the above-mentioned amplified usual and fluorescent image data, it synchronizes with the timing controller 7.

The usual frame memory for image memory 25 (it consists of the frame memory of RGB), the frame memory for (lambda) 1 image memory 26, the multiplexer 28 separated to the frame memory for (lambda) 2 image memory 27, in order to clarify the characteristic of a tissue from the fluorescent image, with the calculation circuit 29, it is the frame memory for (lambda) 1 image memory 26, and (lambda) 2 the frame memory for image memory 27.

The superimpose circuit 30 which synthesises

の画像と演算回路２９の画像を合成するスーパインポーズ回路３０と、このスーパインポーズ回路３０及び前記タイミングコントローラ７を制御するコンピュータ３１とよりなる。

the image of the usual frame memory for image memory 26, and the image of the calculation circuit 29, the computer 31 which controls this superimpose circuit 30 and the above-mentioned timing controller 7.

It consists of these.

【００２０】

次にこの実施例の作用を説明する。まず、光源装置２より例えば１／７２０Ｓの周期でパルス化された励起光λ０と例えば１／３０Ｓ周期の観察光（Ｒ，Ｇ，Ｂ）で時分割で交互に組織３に照射する。

[0020]

Next an effect of this embodiment is demonstrated.

First, excitation-light (lambda)0 pulse-ized, for example, with the period of 1/720S from the light source device 2, for example, it irradiates to a tissue 3 alternately in time slices with the observation light (R, G, B) for a 1/30S period.

【００２１】

図３はチョッパ１０と、回転シャッタ１３，第１のフィルタ１２，第２のフィルタ１７のタイミングを示す。回転シャッタ１３と第１のフィルタ１２は交互に開くようになっており、第２のフィルタ１７は回転シャッタ１３と第１のフィルタ１２に同期し、つまり回転シャッタ１３が開いて励起光を組織３に照射している時λ１，λ２のフィルタが観察光路上に順次配置され、通常光（Ｒ，Ｇ，Ｂ）を組織３に照射している時、フィルタを取り除いている。さらに、励起光はチョッパ１０により１／７２０Ｓで明滅される。

[0021]

Diagram 3 shows the timing of a chopper 10, the rotation shutter 13 and the first filter 12, and the 2nd filter 17.

The rotation shutter 13 and the first filter 12 are opened alternately.

The 2nd filter 17 synchronizes with the rotation shutter 13 and the first filter 12.

When the rotation shutter 13 opens in other words and excitation light is irradiated to the tissue 3, (lambda)1, (lambda)2 filters are sequentially configured on the observation optical path.

When having irradiated the ordinary light (R, G, B) to the tissue 3, the filter is removed, and furthermore, the blinking of the excitation light is carried out by the chopper 10 by 1/720S.

【００２２】

[0022]

さらに詳しく説明すると、回転シャッタ１３は図３（ａ）に示すように１／３０Ｓ周期の２／３の期間開口し、この期間は図３（ｂ）に示すように第１のフィルタ１２は遮光部(閉で示す)となり、図３（ｄ）に示すように開閉するチョッパ１０でレーザ光は明滅され、回転シャッタ１３はパルス化された励起光λ０を通す（この期間は第１のフィルタ１２は遮光部となり、Ｒ，Ｇ，Ｂ光を遮光する）。この励起光λ０はダイクロイックミラー１４で反射され、レンズ１５を経て組織３に照射され、励起光λ０より長い蛍光を発光させる。

In greater detail, as shown in Diagram 3 (a), two thirds of 1/30S period carries out the period opening of the rotation shutter 13.

As this period is shown in Diagram 3 (b), the first filter 12 serves as a shading part (shown closed).

The blinking of the laser light is carried out by the chopper 10 opening and closing as shown in Diagram 3 (d).

The rotation shutter 13 passes through pulse-ized excitation-light (lambda)0. (As for the first filter 12, this period serves as a shading part r, G, and B light is shaded.

This excitation-light (lambda)0 is reflected by the dichroic mirror 14, and it is irradiated by the tissue 3 through a lens 15.

Fluorescence longer than excitation-light (lambda)0 is made to be emitted.

【００２３】

この蛍光は対物レンズ１６によって第２の回転フィルタ１７を透過する波長成分がＣＣＤ１８に届き、蛍光像を結ぶ。図３（ｃ）に示すように第２の回転フィルタ１７は波長λ１とλ２が順次、撮像光路中に配置され、１／９０Ｓづつ波長λ１とλ２の蛍光像が撮像されることになる。

[0023]

The wavelength component for which this fluorescence permeates the 2nd rotating filter 17 by the objective lens 16 reaches CCD18, and a fluorescent image is formed.

As shown in Diagram 3 (c), as for the 2nd rotating filter 17, wavelength (lambda)1 and (lambda)2 are sequentially configured in an image-pick-up optical path.

Every 1/90S, the wavelength (lambda)1 and (lambda)2 fluorescent images will be recorded

【００２４】

、１／３０Ｓ周期の次の１／３の期間は回転シャッタ１３はレーザ光を遮光する遮光期間となり、この遮光期間には第１のフ

[0024]

The following one third of the 1/30S period turn into the shading period when the rotation shutter 13 shades the laser light.

As for the first filter 12, one of the colour filters

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ィルタ１２はR，G，Bの色フィルタの１つが光路中に順次配置され、R，G，B照明光の１つ（例えばR照明光）が出力され、ダイクロイックミラー１４を透過し、レンズ１５を経て組織３に照射される。

of R, G, and B is sequentially configured in an optical path during this shading period.
One of R, G, and the B illumination lights (for example, R illumination light) is output, dichroic mirror 14 is passed through, and it is irradiated by the tissue 3 through a lens 15.

【００２５】
組織３で反射された例えばR照明光は対物レンズ１６によって第２の回転フィルタ１７を透過し、ＣＣＤ１８にR像を結ぶ。図３（ｃ）に示すように、この期間には第２の回転フィルタ１７は開口部分が撮像光路中に配置される状態となる（図３（ｃ）では（フィルタ）なしで示している）。次の周期の同じタイミングではG照明光での照明及び撮像、さらに次の周期ではB照明光での照明及び撮像が行われることになる。つまり、時分割での励起光と照明光に対応して、ＣＣＤ１８を内蔵した撮像装置４により時分割で撮像が行われる。

[0025]
For example, it reflected with the tissue 3, R illumination light permeates the 2nd rotating filter 17 by the objective lens 16, and the R image forms on CCD18.

As shown in Diagram 3 (c), the 2nd rotating filter 17 will be in the state where an opening part is configured in an image-pick-up optical path in this period (in diagram 3 (c) shown without the (filter)).

At the same timing of the following period , the illumination of G illumination light, and image pick-up, and in the next period , the illumination in B illumination light and an image pick-up will be performed.
In other words, it corresponds to the excitation light and the illumination light in a time division.

An image pick-up is performed in time slices by the image-pick-up apparatus 4 containing CCD18.

【００２６】
このようにして蛍光のうち波長λ１とλ２、さらに通常画像が共通の撮像装置４により前記１／７２０Ｓの周期の半分の１／１４４０Ｓの周期、つまり励起光の明滅に同期して画像信号

[0026]
Thus in the fluorescent, wavelength (lambda)1 and (lambda)2, furthermore the image-pick-up apparatus 4 with a usual shared image, synchronizing with the blinking of the in other words excitation light of the period which is 1/1440S, half of the above-mentioned period of

に変換される。なお、R，G，Bの各照明は１／９０Ｓづつ連続照明されるが、１／１４４０Ｓの周期で繰り返し、読み出される。

1/720S, conversion is carried out to an image signal.

In addition, each illumination of R, G, and B, continuous illumination is carried out each 1/90S.

However, it repeats at 1/1440S periods, and it is read out.

【００２７】

このように高速な画像信号を２次元ロックインアンプ５でＳ／Ｎの向上及び増幅を行う。特に蛍光画像の場合には明滅させた場合の明と滅との画像を差分回路２３で差分処理することによって、明滅に無関係なノイズとか特に低周波で大きくなる１／ｆノイズの影響を大幅に低減化でき、従って微弱な蛍光画像の場合にもＳ／Ｎの良い蛍光画像信号を生成できる。

[0027]

Thus the two-dimensional lock-in amp 5 performs a high-speed image signal an improvement and amplification of S/N.

When a blinking is carried out especially in the case of a fluorescent image by the image of bright and dark differential process in the differential circuit 23, influence of a noise unrelated to a blinking or 1/f noise which becomes large at low frequencies especially can be reduced sharply.

Therefore also in the case of a slight fluorescent image, the good fluorescent image signal of S/N can be generated.

【００２８】

従って、差分回路２３から出力される蛍光画像信号は通常観察の画像信号のレベルから極端にアンバランスになることのないレベルに設定できる。つまり、２次元ロックインアンプ５を通すことにより蛍光画像と通常画像の信号レベルをある程度揃えられるので、蛍光画像のレベルを上げるために、信号処理系内の途中に大幅にゲインを上げる回路を設ける必要がないので、

[0028]

Therefore, the fluorescent image signal output from the differential circuit 23 can be set as the level which does not become extremely unbalanced, from the level of the image signal of a usual observation.

Since the signal level of a fluorescent image and a usual image can be arranged to some extent by passing through the two-dimensional lock-in amp 5 in other words, since the circuit which raises a gain sharply in the middle of the signal processing system does not need to be provided in order to raise the level of a

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そのような場合に通常画像側でしばしば発生するハレーションとか焼き付けの発生などを有効に防止できる。

fluorescent image, in such a case the halation often generated by the usual image side, generating of burning, etc. can be prevented effectively.

【００２９】
もっとも、レーザ光の強度とか、蛍光剤の種類、蛍光の発生効率等により、蛍光の明るさ（強度）が変化するので、観察像の明るさに応じ、積分回路２４の積算回数や、デジタル窓による処理（積算回数によりビット数が多くなり、このデータをビットのどの部分のデータを切り取るかでゲインを変える。）により増幅率を変化させるようにしても良い。

[0029]
Since a fluorescent brightness (strength) varies with a laser intensity of light, the kinds of fluorescence agent, fluorescent generating efficiencies, etc. most, it may be made to change gain by the frequency of integrating of an integration circuit 24, and the process by the digital window depending on the brightness of an observation image. (The number of bits increases by the frequency of integrating a gain is changed according to which part of a bit data are cut off from this data.)

【００３０】
このように増幅された画像信号は画像処理装置６で、蛍光像と通常像に分け、各々を処理し、表示に適した画像データに変換し、さらにスーパインポーズ回路３０で合成し、モニタ８に表示する。

[0030]
Thus the amplified image signal is an image processing device 6, and is divided into a fluorescent and usual image.
Each is processed, and conversion is carried out to the image data suitable for a display.
Furthermore it synthesises in the superimpose circuit 30, and it displays on the monitor 8.

【００３１】
図２は励起光λ０を照射した時の蛍光特性を示す。例えば４４２ｍｍの励起光で得られる組織の蛍光は正常部位ではその強度が強く、病変部では、波長の短い側で正常に比べ弱い。つまり、図中の波長λ１，λ２で

[0031]
Diagram 2 shows the fluorescent characteristic when irradiating excitation-light (lambda)0.

For example, by the normal site, the strength of the fluorescence of the tissue obtained by 442 mm excitation light is strong.

Compared with a normal region it is weak at the side with a wavelength short in a disease

は正常部位の場合と病変部位の場合とでは蛍光強度の比率が異なるので、このλ１，λ２での蛍光強度の比率を求めることで病変部位と正常部位を区別することができる。

part.

Since the case of a normal site differs in the ratio of a fluorescence intensity from the case of a disease site by wavelength (lambda)1, (lambda) 2 in a diagram in other words, a disease site and a normal site are distinguishable by measuring the ratio of the fluorescence intensity of this (lambda)1, (lambda)2.

【００３２】

このため、波長λ１で撮像された画像を格納するフレームメモリ２６と，λ２で撮像された画像を格納するフレームメモリ２７との両画像は演算回路２９で対応する各画像部分で差分を求める演算が行われ、この差分処理された値が設定された値以下か否かを判断し、例えば設定値以下の領域に対してはその領域部分に対しては識別し易い色信号を出力し、スーパインポーズ回路３０を経て通常画像に対し、設定値以下となる病変部の可能性のある領域を色で識別できるようにする。

[0032]

For this reason, the calculation which measures the difference in each image part to which the both image with the frame memory 27 which stores the image recorded by the frame memories 26 and 2 (lambda) which store the image recorded by wavelength (lambda)1 corresponds in the calculation circuit 29 is performed, and it judges whether it is below the value to which this processed differential value was set.

For example, the chrominance signal which tends to carry out an identification in relation to the area part to the area below a setting is output.

The identification of the area with the possibility of the disease part which becomes below a setting in relation to a usual image through the superimpose circuit 30 can be carried out by the colour.

【００３３】

一方、設定値以上の画像の場合には例えば波長λ１とλ２で撮像された両画像を加算してスーパインポーズ回路３０に出力

[0033]

On the one hand, in the case of the image more than a setting, the both image recorded, for example, by wavelength (lambda)1 and (lambda)2 is added, and it outputs to the

し、通常画像に並べるように蛍光画像をスーパインポーズし、２つの画像をモニタ８で表示する。

superimpose circuit 30.
The superimpose of the fluorescent image is carried out so that it may arrange in a usual image, and the image of two is displayed with a monitor 8.

【００３４】
勿論、設定値以下の場合にも同様に表示し、且つ設定値以下の領域を識別し易い色で表示するようにしても良い。さらに、通常画像と一方の波長の画像とを選択して表示したり、２つの蛍光画像を並べて表示する等の機能を設けるようにしても良い。

[0034]
Of course, it displays similarly below the setting value.
And it may be made to display the area below a setting by the colour which is easy to identify.
Furthermore, a usual image and the image of one wavelength are chosen and displayed.
Moreover, it may be made to provide function of displaying the two fluorescent images side by side.

【００３５】
この第１実施例によれば、蛍光画像の撮像と通常画像の撮像を共通のＣＣＤ１８で行うことができると共に、２次元ロックインアンプ５を通すことによって、蛍光画像のＳ／Ｎを大幅に向上でき、通常画像の信号レベルとのアンバランスを縮小できるので、焼き付け等の発生を解消して両方の画像を表示できる。

[0035]
According to this 1st embodiment, while imaging a fluorescent image and imaging a usual image can be performed by shared CCD18, S/N of a fluorescent image can be sharply improved by passing through the two-dimensional lock-in amp 5.
Since the imbalance with the signal level of a usual image is reducible, generating of burning etc. is eliminated and both images can be displayed.

【００３６】
又、簡単な構成で蛍光像と通常像の両方を撮影できるので、良好なオリエンテーションと高感度な蛍光観察の両機能を提供し、より精度の高い診断及び観

[0036]
Moreover, since a photograph of both fluorescent image and usual image can be taken with simple composition, both function of a good orientation and a fluorescent high sensitivity observation is provided, and a more

察が可能となる。

【００３７】
また、撮像部とか信号処理系を共通使用できるので、両画像に対応できる装置を低コストで実現できる。この第１実施例ではＣＣＤ１８で説明したが、ＣＣＤ以外のＣＭＤ，ＳＩＴ，ＭＯＳ等の固体撮像素子を用いても良い。

【００３８】
次に本発明の第２実施例を説明する。図４ないし図８は本発明の第２実施例に係り、図４は第２実施例の蛍光観察装置の構成を示し、図５は動作説明図を示し、図６は光源選択手段の１例を示し、図７は光源選択手段の他の例を示し、図８は波長選択手段の具体例を示す。この実施例は蛍光像と通常像の明るさに応じ、積算回数を制御する例を示す。

accurate diagnosis and an observation can be performed.

[0037]
Moreover, since the shared usage of an image-pick-up part or the signal processing system can be carried out, the apparatus which can correspond to both images is realizable at low cost.

CCD18 is demonstrated in this 1st embodiment.

However, solid-state image sensors other than CCD, such as CMD, SIT, and MOS, may be used.

[0038]
Next the second embodiment of this invention is demonstrated.

Fig. 4 or 8 concerns the second embodiment of this invention.

Diagram 4 shows the composition of the fluorescent observation apparatus of a second embodiment.

Diagram 5 shows an explanatory drawing of operation.

Diagram 6 shows 1 example of light-source choice means.

Diagram 7 shows the other example of light-source choice means.

Diagram 8 shows the example of wavelength-selection means.

This embodiment shows the example which controls the frequency of integrating, depending on the brightness of a fluorescent image and a usual image.

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【００３９】
蛍光像は通常像に比べ極めて暗くなるとともに、その蛍光の明るさは、励起波長、強度の違い、自家蛍光と薬剤による蛍光，その薬剤の種類等によって変化する。本実施例では上記のごとく蛍光像の明るさが変化し、通常像との明るさの割合が変化しても各々の像の両方を良好に表示する。

[0039]
While a fluorescent image becomes very dark compared with a usual image, the fluorescent brightness is the difference of an excitation wavelength and strength.

It varies with a self-fluorescence, the fluorescence by the chemical agent, the kinds of the chemical agent, etc.
In this embodiment, the brightness of a fluorescent image varies as mentioned above.

Even when the ratio of the brightness with a usual image varies, both of each images are displayed satisfactorily.

【００４０】
本実施例の蛍光観察装置４０は励起光を発生するレーザ４１と、通常照明光を発生するランプ４２と、前記励起光又は照明光を適当に選択する光源選択手段４３と、上記各光を生体組織３に照射し、その反射光（通常）又は蛍光を対物レンズ４４を通じ画像として検出する撮像素子４５（例えばＣＣＤ，ＣＭＤ，ＳＩＴ）と、前記反射光又は蛍光を選択する波長選択手段４６と、前記撮像素子４５を高速に例えば３０～２０００フレーム／Ｓで駆動するドライバ４７と、前記光源選択手段４３と波長選択手段４６，ドライバ４７を同期制御する制御回路４８と、前記撮像素子４５をデジタルデータに変換するＡ／Ｄ変換器４９と、このデジタルデータ

[0040]
With the laser 41 which generates excitation light, the fluorescent observation apparatus 40 of this embodiment, the lamp 42 which generates a usual illumination light, light-source choice means 43 to choose suitably above-mentioned excitation light or an illumination light, image-pick-up element 45 (for example, CCD, CMD, SIT)) which irradiates each light to the organism tissue 3, and detects as image the reflected light (usually) or fluorescence through an objective lens 44, wavelength-selection means 46 to choose above-mentioned reflected light or the above-mentioned fluorescence, the driver 47 which actuates the above-mentioned image-pick-up element 45 by 30-2000 frames/S at high speed, above-mentioned light-source choice means 43, wavelength-selection means 46, and the controlling circuit 48 which carries out synchronous control of the driver 47, a/D converter 49 which carries out conversion of the above-mentioned image-pick-up element 45 to

を積算する積算器５０と、前記蛍光による蛍光像と反射光による通常像を第１の画像メモリ５１と第２の画像メモリ５２に振り分けるマルチプレクサ５３と、画像メモリ５１、５２の画像を合成するスーパインポーズ回路５４と、それを表示するモニタ５５とより構成される。

digital data, the integrator 50 which carries out integrating of this digital data, the multiplexer 53 which distributes the usual image by the fluorescent image and the fluorescent reflected light by the above-mentioned fluorescence to the first image memory 51 and the 2nd image memory 52, it consists of the superimpose circuit 54 which synthesises the image of the image memories 51 and 52, and the monitor 55 which displays it.

【００４１】

まずレーザ４１による励起光とランプ４２による照明光を光源選択手段４３で適当に選択する。生体組織３の病変部３ａ等より発生する、蛍光又は反射光に合わせ、波長（例えば蛍光なら図３の示すλ１，λ２，照明光ならそのまま）を波長選択手段４６で選択し、これを撮像素子４５で受ける。これをＡ／Ｄ変換後、積算器５０で蛍光及び通常像の明るさに応じて積分し、蛍光像は第１の画像メモリ５１へ、通常像は第２の画像メモリ５２へ振り分け、スーパーインポーズ回路５４で各々画像を合成し、モニタ５５に表示する。

[0041]

The excitation light by the laser 41 and the illumination light by the lamp 42 are first chosen suitably with light-source choice means 43.

Matching the fluorescence or the reflected light generated from disease part 3a of the organism tissue 3 etc, a wavelength (for example, if it is (lambda)1, (lambda)2 which Diagram 3 shows if it is a fluorescence, and an illumination light as it is) is chosen with wavelength-selection means 46, and this is received with the image-pick-up element 45.

This is integrated depending on the brightness of a fluorescence and a usual image by the integrator 50 after A / D conversion.

A fluorescent image is distributed to the first image memory 51, and a usual image is distributed to the 2nd image memory 52.

Each image is synthesised in the superimposition circuit 54, and it displays on the monitor 55.

【００４２】

図５は図４の実施例のタイミングを示す。まず、撮像素子４５

[0042]

Diagram 5 shows the timing of the embodiment in the diagram 4.

を例えば１８０フレーム／Ｓで高速駆動する。もし、観察像に対し、蛍光像を５倍感度を上げるとすると、図５のようにレーザと照明光（Ｘｅで示す）の照射時間割合を５対１とし、これに合わせ、通常像１フレームに対し蛍光像を５フレーム分積分することで蛍光像の感度を向上することができる。尚、図５中のWは通常像のための照明光を示す。

First, high-speed actuation of the image-pick-up element 45 is carried out, for example, by 180 frames/S.

Supposing it raises a fluorescent image by 5 times sensitivity in relation to an observation image, as shown in Diagram 5, the irradiation time ratio of a laser and an illumination light (Xe shows) will be set to 5 to 1.

The sensitivity of a fluorescent image can be improved by matching to this and integrating a fluorescent image by 5 frames to one usual image.

In addition, W in Diagram 5 shows the illumination light for a usual image.

【００４３】

図６は波長選択手段４３の一例を示す。図６（ａ）のようにレーザ４１とランプ４２の光軸が一致するように回転自在の回転板５６の面を光軸に対し、ある角度で配置されている。この回転板５６は、図６（ｂ）に示すように一部が光を透過する透過窓５７と、光を反射する反射鏡５８があり、それぞれが突出部５９に連動して、透過窓５７のひらく角度が変化するようになっている。

[0043]

Diagram 6 shows an example of wavelength-selection means 43.

The surface of the rotatable rotation board 56 is situated on a certain angle to the optical axis so that the optical axis of a laser 41 and the lamp 42 may be in agreement, as shown in Diagram 6 (a).

This rotation board 56 has the permeation window 57 in which a part permeates a light as shown in Diagram 6 (b), and the reflective mirror 58 which reflects a light.

Each is interlocked with the projection part 59.

The angle at which the permeation window 57 opens varies.

【００４４】

つまり、この回転板５６をステッピングモータ６０で回転させつつ、マイクロステージ６１に取り付けられた溝６２で突出部

[0044]

In other words, the projection part 59 is moved in the groove 62 installed in the micro stage 61, rotating this rotation board 56 by the stepping motor 60.

５９を動かし、透過窓の角度を変えることで励起光と、照明光の割合を変化させることができる。適切な割合に設定された後、溝６２は退避され、突出部５９が係入されない状態にされる。

The ratio of excitation light and an illumination light can be changed by changing the angle of the permeation window.
Groove 62 is retreated after setting it to the suitable ratio.

It is made to be the state where the projection part 59 is not inserted.

【００４５】
図７は波長選択手段４３の別の一例を示す。レーザ４１及びランプ４２の前に電子シャッタ６３，６４を配置し、一方の電子シャッタ６４には反転回路６５を付加し、２つの電子シャッタ６３，６４を反転制御することで交互に光を出すことができる。この光をダイクロイックミラー６６により同一光路に導く。

[0045]
Diagram 7 shows another example of wavelength-selection means 43.
The electronic shutters 63 and 64 are configured before the laser 41 and the lamp 42. The inversion circuit 65 is added to one electronic shutter 64.

Light can be alternately given off by inversely controlling the electronic shutters 63 and 64 of two.

This light is guided to the same optical path by the dichroic mirror 66.

【００４６】
図８は波長選択手段４６の具体例を示す。図８（ａ）に示すようにこの波長選択手段４６は励起光をカットするカットフィルタ６７と、偏光板６８，ＴＮセル６９，カラー偏光板７０より成る液晶フィルタ７１より構成される。

[0046]
Diagram 8 shows the example of wavelength-selection means 46.

As shown in Diagram 8 (a), this wavelength-selection means 46 consists of the cut filter 67 which cuts excitation light, and the liquid-crystal filter 71 which consists of a polarizing plate 68, the TN cell 69, and the colour polarizing plate 70.

【００４７】
図８（ｂ）に示すように液晶フィルタ７１はＯＮ状態でカラー偏光板の波長特性に対応した蛍光が透過し（例えばλ１又はλ

[0047]
As shown in Diagram 8 (b), the fluorescence which corresponded to the wavelength characteristic of a colour polarizing plate in the state of ON permeates the liquid-crystal filter 71

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２）、ＯＦＦ状態では全ての波長領域の光を透過し、通常光を撮像素子４５に導く。

(permeating the light of all wavelength areas, for example, in the state of (lambda)1 or (lambda)2), OFF), and an ordinary light is guided to the image-pick-up element 45.

【００４８】
この第２実施例によれば蛍光像の明るさが変化しても通常像と両方とも良好に表示できる。さらに、第２実施例に第１実施例の２次元ロックインアンプを組み合わせることでよりＳ／Ｎを向上できる。

[0048]
Even if the brightness of a fluorescent image varies according to this second embodiment, a usual image and both can be displayed satisfactorily.

Furthermore, S/N can be more improved by combining the two-dimensional lock-in amp of the 1st embodiment with a second embodiment.

【００４９】
図９は、例えば第１及び第２実施例を内視鏡に適用した第３実施例の蛍光観察内視鏡装置７２を示しており、この内視鏡を用いることで体腔内を蛍光観察でき、初期癌等の病変のスクリーニングが可能となる。なお、第１及び第２実施例と同じ構成要素は同じ符号で示す。

[0049]
Diagram 9 shows the fluorescent observation endoscope apparatus 72 of the 3rd embodiment which applied the first and second embodiment to the endoscope, for example.

The fluorescence observation of the intra-corporeal can be carried out by using this endoscope, and the screening of diseases, such as early cancer, is made.

In addition, the same code shows the same component as in the first and second embodiments.

【００５０】
この蛍光観察内視鏡装置７２は、体腔内に挿入する内視鏡７３と、光源装置２と，２次元ロックインアンプ５と，画像処理装置６と、タイミングコントローラ７と、モニタ８とより構成される。内視鏡７３の挿入部７

[0050]
This fluorescent observation endoscope apparatus 72 consists of the endoscope 73 inserted intra-corporeal, the light source device 2, the two-dimensional lock-in amp 5, an image processing device 6, a timing controller 7, and a monitor 8.

A light guide 75 is passed through the insertion

４内にはライトガイド７５が挿通され、その手元側の端部は光源装置２に接続され、光源装置２からの照明光を導光する。

part 74 of an endoscope 73.
The edge part on the operator side is connected to a light source device 2.

The light-guide of the illumination light from a light source device 2 is carried out.

【００５１】

光源装置２は図１に示す第１実施例とほぼ同じ構成である。レーザ９の励起光はモータ１０ａで回転されるチョッパ１０を経てパルス光にされ、ミラー７７ａ、回転面にミラー部と透過部（図９では点線で示す）とが設けられた回転ミラー７７ｂのミラー面でそれぞれ反射されてライトガイド７５の手元側の端部に入射される。この回転ミラー７７ｂの回転はタイミングコントローラ７により制御される。

[0051]

A light source device 2 is nearly the same composition as the 1st embodiment shown in Diagram 1.
The excitation light of a laser 9 are made into pulsed light through the chopper 10 rotated by motor 10a.

It respectively reflects with respect to the mirror of rotation mirror 77b by which the mirror part and the permeation part (a dotted line shows in Diagram 9) were provided on mirror 77a and the plane of rotation, and incidence is carried out to the edge part in front of a light guide 75.

Rotation of this rotation mirror 77b is controlled by the timing controller 7.

【００５２】

また、キセノンランプ１１からの光は、モータ１２ａで回転され、光路上に配置されたＲＧＢ回転フィルタ１２を通り、光路上に達したタイミングでの（回転ミラー７７ｂの）透過部を経てライトガイド７５の手元側の端部に入射される。ライトガイド７５の手元側の端部に入射された光は、挿入部７４が挿入される体腔内に導光し、先端面からさらに照明レンズ７６を経て

[0052]

Moreover, the light from a xenon lamp 11 is rotated by motor 12a.

It passes along RGB rotating filter 12 configured in the optical path, and incidence is carried out to the edge part in front of a light guide 75 through the permeation part (rotation mirror 77b) in the timing attained in the optical path.
The light-guide of the light by which incidence was carried out to the edge part in front of a light guide 75 is carried out to the intra-corporeal in which an insertion part 74 is

体腔内組織側に出射する。

inserted.

A radiation is carried out to intra-corporeal tissue side through the illumination lens 76 furthermore from the end surface.

【００５３】
この体腔内組織より発生した蛍光及び通常の光は、内視鏡先端部の観察窓に取り付けたカバーガラス、偏光板６７、対物第１レンズ４４ａ、液晶フィルタ７１、対物第２レンズ４４ｂ、を経て先端部内に配置された撮像素子４５に結像され、この撮像素子４５で光電変換される。

[0053]
The fluorescence generated from this intra-corporeal tissue and a usual light is image-formed by the cover glass installed in the observation port of an endoscope end, the polarizing plate 67, object 1st lens 44a, the liquid-crystal filter 71, and the image-pick-up element 45 configured through object second lens 44b at end part.

A photoelectric conversion is carried out with this image-pick-up element 45.

【００５４】
この撮像素子４５はドライバ４７からの駆動信号で駆動され、この撮像素子４５で光電変換された撮像信号はプレアンプ７９で増幅された後、２次元ロックインアンプ５を形成するＡ／Ｄ変換器２０と、画像処理装置６内のビデオプロセッサ８１に入力される。

[0054]
This image-pick-up element 45 is actuated by the actuation signal from a driver 47.

After amplifying the image-pick-up signal by which the photoelectric conversion was carried out with this image-pick-up element 45, with the pre amp 79, it is input into A/D converter 20 which forms the two-dimensional lock-in amp 5, and the video processor 81 in an image processing device 6.

【００５５】
ビデオプロセッサ８１は通常光の照明の場合での撮像信号に対する信号処理を行うものであり、標準的な映像信号を生成し、スーパインポーズ回路３０′を介してモニタ８に出力され、通常像を表示する。

[0055]
The video processor 81 performs the signal processing opposing to the image-pick-up signal in the case of the illumination of ordinary light, and a standard video signal is formed.
It is output to a monitor 8 via superimpose circuit 30', and a usual image is displayed.

【００５６】
一方、蛍光により撮像された撮像信号はＡ／Ｄ変換器２０を経てデジタル信号に変換された後、ＯＤＤのフレーム像とＥＶＥＮのフレーム像を記憶するフレームメモリ２２ａ，２２ｂ、これらの差分を求めるを経て差分回路２３、差分出力を積分する積分回路２４を経て画像処理装置６内のマルチプレクサ２８に入力される。

【００５７】
このマルチプレクサ２８で選択された信号はフレームメモリ２６、２７に一時記憶され、これらのフレームメモリ２６、２７から読み出された２つの信号は演算回路２９で演算されて、組織の性状の判別に応じた信号にした後、Ｄ／Ａ変換器８２でアナログの信号に変換した後、ビデオプロセッサ８３で標準的な映像信号を生成し、スーパインポーズ回路３０′に出力する。

【００５８】
そして例えば、病変部であると判断した場合には蛍光像を特定の色信号でスーパインポーズ回路３０′に出力し、その蛍光像を、通常像にスーパーインポーズして表示したり、通常画像と蛍光画像とを並べるようなスー

[0056]
After on the one hand carrying out conversion of the image-pick-up signal recorded by the fluorescence to a digital signal through A/D converter 20

For the frame memories 22a and 22b which store the frame image of ODD, and the frame image of EVEN, these differences are measured, it is input into the multiplexer 28 in an image processing device 6 through the differential circuit 23 and the integration circuit 24 which integrates a differential output.

[0057]
The temporary memory of the signal chosen by this multiplexer 28 is carried out to frame memories 26 and 27.

The signal of the two readout from these frame memories 26 and 27 was calculated in the calculation circuit 29.
After making to a signal indicating the characteristic distinction of the tissue, After transforming into the signal of an analog with D / A converter 82, a standard video signal is formed by the video processor 83.

It outputs to superimpose circuit 30'.

[0058]
And when it is judged for example, that it is a disease part, a fluorescent image is output to superimpose circuit 30' by the specific chrominance signal.

The fluorescent image is superimposed and displayed with the usual image.

Moreover, a superimpose process which puts

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パインポーズ処理して２つの画像を同時に表示したりする。なお、コンピュータ３１はタイミングコントローラ７とスーパインポーズ回路３０′を制御する。

a usual image and a usual fluorescent image in order is carried out, and the image of two is displayed simultaneously.

In addition, a computer 31 controls the timing controller 7 and superimpose circuit 30'.

【００５９】

この蛍光観察内視鏡装置７２によれば、通常の内視鏡画像の他に蛍光画像も表示できるし、病変組織の可能性のある領域を識別しやすいように表示することもできる。

[0059]

According to this fluorescent observation endoscope apparatus 72, a fluorescent image can also be displayed besides a usual endoscope image.

And, it can also display so that it may be easy to distinguish between the area with the possibility of lesioned tissue.

【００６０】

従って、初期癌等の病変のスクリーニングに非常に有効な手段を提供できることになる。なお、図９において、回転ミラー７７ｂとして例えば図１の回転シャッタ１３の遮光部にミラーとして機能するアルミニュウム等をメッキ或は蒸着したものを用いることができる。また、プランジャにミラーを設け、プランジャを一定の周期で駆動してミラーを光路中に配置したり、退避させるようにしても良い。また、ミラーを一定角度だけ往復回動させて、ミラーを光路中に配置したり、退避させるようにしても良い。

[0060]

Therefore, very effective means in the screening of diseases, such as early cancer, can be provided.

In addition, in Diagram 9, plating or depositing can use the aluminium functioning as a mirror among the shading part of the rotation shutter 13 in the diagram 1, using as rotation mirror 77b.

Moreover, a mirror is provided on a plunger.

The plunger is made to move with a fixed period and the mirror is configured in an optical path.

Moreover, it may be made to make it evacuate.

Moreover, only a fixed angle carries out both-way rotating of the mirror.

The mirror is configured in an optical path.

Moreover, it may be made to make it evacuate.

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【００６１】
さらに、ミラーにより時分割で励起光と照明光とを順次ライトガイド７５側に導光する場合と、手動等で一方のみを選択的に導光できるように切換えられるようにしても良い。このようにして、必要となる場合のみに、蛍光観察できるようにしても良い。他の実施例に対しても同様の機能を設けても良い。

[0061]
Furthermore, when the light-guide of excitation light and the illumination light is sequentially carried out to a light-guide 75 side in time slices by the mirror, It may be made to be switched so that the light-guide only of one of them can be selectively done by manual operation etc.

Performing like the above, only when needed, it is made to carry out a fluorescence observation.

The same function may be provided also in relation to the other embodiment.

【００６２】
図１０及び図１１は内視鏡を用いたシステムを示す。Ｓ字結腸切除による太陽吻合において、その吻合部位において、その吻合部位の代謝を知ることは縫合不全を防ぐ意味から重要である。一方、生体組織に含まれるＮＡＤＨは酸素代謝をつかさどる物質で、この蛍光を見ることで、例えば縫合部の代謝状況を診断できる。図１０及び図１１は上記目的のため、ＮＡＤＨを測定する例である。

[0062]
Fig. 10 and 11 shows the system using the endoscope.

In the solar anastomosis by the S shaped colon resection, it is important to know the metabolism of the anastomosis region from the implication which prevents the suture failure.

On the one hand, NADH contained in an organism tissue is the matter which manages oxygen metabolism. by seeing this fluorescence, for example, the metabolism situation of a suture part can be diagnosed.

Fig. 10 and 11 is an example which measures NADH, because of the above-mentioned objective.

【００６３】
まず、図１０を参照して説明する。この内視鏡観察システム１０１は、内視鏡１０２と、光源装置１０３と、信号処理装置１０４と、モニタ１０５とから構

[0063]
First, it demonstrates with reference to Diagram 10.

This endoscope observation system 101 consists of an endoscope 102, a light source device 103, a signal-processing apparatus 104,

成される。

【００６４】
光源装置１０３は白色光源１０７を内蔵し、その照明光路上にＮＡＤＨを励起する光を通過させるバンドパスフィルタ１０８が、例えばモータ１０９の回動により退避可能に設けてある。このバンドパスフィルタ１０８の前方位置にコンデンサレンズ１１０が配置され、光源装置１０３に装着されるライトガイド１１１の手元側端面に照明光を供給する。

【００６５】
内視鏡１０２に設けられたこのライトガイド１１１は、軟性の挿入部１１２内を挿通され、白色光あるいは励起光を伝送し、先端部の照明窓に取り付けられた先端面から前方に出射され、例えば大腸１１３の縫合部１１４に照射される。

【００６６】
白色光の反射光或は蛍光は先端部の観察窓に取り付けた対物レンズ１１５によりその焦点面に配置されたイメージガイド１１６の先端面に像を結ぶ。そして、このイメージガイド１１６により、蛍光による像あるいは反射光による像が手元側の後端面に伝送される。

and a monitor 105.

[0064]
A light source device 103 builds in the white light source 107.

Evacuation is provided the band-pass filter 108 which passes the light which excites NADH, possible, for example, by rotating of a motor 109 on the illumination optical path.
A condenser lens 110 is situated on the front position of this band-pass filter 108.

An illumination light is supplied to the front side end face of the light guide 111 in which a light source device 103 is loaded.

[0065]
This light guide 111 provided on the endoscope 102 is passed through the inside of the soft insertion part 112, and white light or excitation light is transmitted.
It radiates from the front end surface installed in the illumination window of the end.

For example, it is irradiated by the suture part 114 of large intestine 113.

[0066]
The reflected light or the fluorescence of white light is by the objective lens 115 installed in the observation port of the end. An image is formed on the end surface of the image guide 116 configured in the focal plane.

And, the image by the fluorescence or the image by reflected light is transmitted to the back side surface by this image guide 116.

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【００６７】
この後端面に対向して励起光をカットするカットフィルタ１１７と、結像レンズ１１８と、ＣＣＤ１１９とが順次配置され、このＣＣＤ１１９で光電変換された信号は信号処理回路１０４内のＣＣＵ１２０に入力され、映像信号に変換される。このＣＣＵ１２０は図９の２次元ロックインアンプ５の機能も有する。

[0067]
The cut filter 117 which opposes this back side surface and cuts excitation light, the image-formation lens 118, and CCD119 are sequentially configured.
The signal by which the photoelectric conversion was carried out by this CCD119 is input into CCU120 in the signal-processing circuit 104.
conversion is carried out to a video signal.
This CCU120 also has function of the two-dimensional lock-in amp 5 in the diagram 9.

【００６８】
信号処理回路１０４は、上記ＣＣＵ１２０と、このＣＣＵ１２０から出力される映像信号は蛍光像及び通常像それぞれの画像を蓄積するメモリ１２１と、このメモリ１２１に蛍光と通常の像を分離するためとバンドパスフィルタ１０８の開閉を制御するタイミング制御信号を出力するタイミングコントローラ１２２と、両方の画像を合成するスーパーインポーズ回路１２３とより構成される。

[0068]
Signal-processing circuit 104, above CCU120, memory 121 which carries out storage of the image of a fluorescent image and each usual images, the video signal output from this CCU120 , the timing controller 122 which outputs the timing-control signal which controls an opening-closing of the band-pass filter 108 in order to separate a fluorescence and a usual image in this memory 121, and the superimposition circuit 123 which synthesises both of images.
It consists of these.

【００６９】
この内視鏡システム１０１の作用については前述の蛍光内視鏡装置７２とほぼ同じなので略する。また、その効果も同様である。尚、軟性鏡の他、硬性鏡でもほぼ同様に応用できる。

[0069]
Since it is almost the same as that of the above-mentioned fluorescent endoscope apparatus 72 about an effect of this endoscope system 101, it is abbreviated.
Moreover, the same is said of the effect.
In addition, it can apply almost similarly in a

hard mirror besides a soft mirror.

【００７０】
次に図１１の内視鏡システム１３１を説明する。本実施例は蛍光画像を得るのではなく、内視鏡のチャンネル内に挿通した光プローブで導光し、その先端を縫合部位に接触させ、接触部位の代謝をＮＡＤＨの蛍光で測定する例である。

[0070]
Next the endoscope system 131 in the diagram 11 is demonstrated.
This embodiment carries out a light-guide with the optical probe passed through the channel of an endoscope rather than it obtains a fluorescent image.
A suture site is made to contact the end.
It is the example which measures metabolism of a contact site by the fluorescence of NADH.

【００７１】
この内視鏡システム１３１は、内視鏡１３２と、この内視鏡１３２に白色照明光を供給する光源装置１３３と、この内視鏡１３２のチャンネル１３４に挿通された導光プローブ１３５と、この導光プローブ１３５に励起光を供給する第２の光源装置１０３と、導光プローブ１３５で導光された蛍光を検出する検出装置１３６と、この検出装置１３６により検出された蛍光より代謝を求める分析装置１３７と、その結果を示す表示装置１３８より構成される。この分析装置１３７は図９の２次元ロックインアンプ５の機能を有する。

[0071]
This endoscope system 131, an endoscope 132 and the light source device 133 which supplies a white illumination light to this endoscope 132, the light-guide probe 135 passed through by the channel 134 of this endoscope 132, the 2nd light source device 103 which supplies excitation light to this light-guide probe 135, the detector 136 which detects the fluorescence by which the light-guide was carried out with the light-guide probe 135, the analyser 137 which measures metabolism from the fluorescence detected by this detector 136, and the display device 138 which shows the result
It consists of these.
This analyser 137 has function of the two-dimensional lock-in amp 5 in the diagram 9.

【００７２】
内視鏡１３２は、細長で軟性の挿入部１４１内にライトガイド

[0072]
An endoscope 132 is long and slender and a light guide 142 is passed through the soft

１４２が挿通され、このライトガイド１４２の手元側端部は光源装置１３３に接続され、白色光源１４３からの白色光がコンデンサレンズ１４４を介して供給される。この白色光は挿入部１４１の先端部の照明窓から前方に出射され、例えば大腸１１３の縫合部１１４側に照射される。

insertion part 141.
The front part of this light guide 142 is connected to light source device 133.

White light from the white light source 143 is supplied via condenser lens 144.
This white light radiates from the illumination window on the end of insertion part 141.

For example, it is irradiated at the suture part 114 side of large intestine 113.

【００７３】
縫合部１１４側で反射された光は観察窓に取り付けた対物レンズ１１５によりその焦点面に配置されたイメージガイド１１６の先端面に像を結ぶ。このイメージガイド１１６で後端面に伝送され、接眼レンズ１４６を介して肉眼で、縫合部１１４側を観察できる。

[0073]
The light reflected by the suture part 114 side is, by the objective lens 115 installed in the observation port, an image is formed at the end surface of the image guide 116 situated on the focal plane.
It transmits to a back side surface in this image guide 116.

With the naked eye, the suture part 114 side can be observed via an eyepiece 146.

【００７４】
この内視鏡１３２のチャンネル１３４内に挿通された導光プローブ１３５の手元側は２本に分岐され、一方は光源装置１０３に、他方は検出装置１３６に接続される。

[0074]
The front of the light-guide probe 135 passed through the channel 134 of this endoscope 132 is branched into two.

One side is connected to a light source device 103, and another side is connected to a detector 136.

【００７５】
この光源装置１０３は図１０で説明したものと同じ構成であり、励起光を導光し、チャンネル１３４の先端出口から突出する先端面から、この先端面に接

[0075]
This light source device 103 is the same composition as what was demonstrated in Diagram 10.
The light-guide of the excitation light is carried out.

触する縫合部１１４側に導光した励起光を照射する。縫合部１１４側からの励起光はこの導光プローブ１３５で手元側に導光され、励起光をカットするカットフィルタ１１７を経て検出器１４７で検出される。検出された励起光の光量は分析装置１３７で分析され、表示装置１３８で表示される。

The excitation light which carried out the light-guide to the suture part 114 side contacted to this end surface from the end outlet of channel 134 from the projecting end surface are irradiated.
The light-guide of the excitation light from the suture part 114 side is carried out to the front of this light-guide probe 135.
Detector 147 detects through the cut filter 117 which cuts excitation light.
The quantity of light of the detected excitation light is analyzed by the analyser 137, and it displays by the display device 138.

【００７６】
尚、ＮＡＤＨの蛍光の他、近赤外光を使い、チトクロームを測定したり、レーザドップラー計で血流を測定し、代謝を求めても良い。なお、上述した各実施例等を部分的等で組み合わせて異なる実施例を構成しても良い。

[0076]
In addition, a near-infrared light besides the fluorescence of NADH is used, cytochrome is measured, and moreover, blood flow is measured with a laser Doppler instrument.
Metabolism may also be measured.
In addition, a differing embodiment which combines each above-mentioned embodiment in partial etc, may be constituted.

【００７７】

[0077]

【発明の効果】
以上説明したように本発明によれば、通常照明光と励起光を時分割で照射し、対象物に照射された照明光又は励起光による観察像又は蛍光像を選択手段で選択し選択された画像を光照射と同期させて、共通の撮像手段で観察像又は蛍光像を撮像し、こ

[EFFECT OF THE INVENTION]
As explained above, according to this invention, usual and excitation light is irradiated in time slices. The image which chooses the observation image by the illumination light or the excitation light irradiated to the target object or a fluorescent image with choice means, and was chosen is synchronized with optical irradiation.

の撮像手段により撮像した画像を、画像処理手段により少なくとも蛍光像に対しては差分処理等を行うようにしているので、共通の撮像手段で蛍光画像と通常画像とを撮像できると共に、画像処理手段により蛍光像のS／Nを大幅に向上しているので、通常画像との信号レベルのアンバランスを縮小でき、従ってハレーション等の発生を防止できる。

An observation image or a fluorescent image is recorded with shared image-pick-up means. With the image recorded by this image-pick-up means, since image-processing means is made to perform a differential process etc. in relation to the fluorescent image at least, since S/N of a fluorescent image is sharply improved by image-processing means while a fluorescent and usual image can be recorded with shared image-pick-up means, the imbalance of the signal level with a usual image is reducible.

Therefore generating of halation etc. can be prevented.

【図面の簡単な説明】

[BRIEF EXPLANATION OF DRAWINGS]

【図１】
第１実施例の蛍光観察装置の全体構成図。

[FIGURE 1]
The entire block diagram of the fluorescent observation apparatus of the 1st embodiment.

【図２】
正常部と病変部の場合における蛍光強度分布の１例を示す特性図。

[FIGURE 2]
The characteristic view showing 1 example of the fluorescence-intensity distribution in the case of a normal part and a disease part.

【図３】
第１実施例の動作説明用のタイミングチャート。

[FIGURE 3]
The timing chart for description of the 1st embodiment of operation.

【図４】
本発明の第２実施例の蛍光観察装置の全体構成図。

[FIGURE 4]
The entire block diagram of the fluorescent observation apparatus of the second embodiment of this invention.

【図５】

[FIGURE 5]

第２実施例の動作説明図。

Explanatory drawing of a second embodiment of operation.

【図６】
光源選択手段の１例を示す説明図。

[FIGURE 6]
Explanatory drawing showing 1 example of light-source choice means.

【図７】
光源選択手段の他の例を示す説明図。

[FIGURE 7]
Explanatory drawing showing the other example of light-source choice means.

【図８】
波長選択手段の具体例を示す説明図。

[FIGURE 8]
Explanatory drawing showing the example of wavelength-selection means.

【図９】
本発明の第３実施例の蛍光内視鏡装置の構成を示す構成図。

[FIGURE 9]
The block diagram showing the composition of the fluorescent endoscope apparatus of the 3rd embodiment of this invention.

【図１０】
縫合部の代謝状況の診断に適した内視鏡システムの構成図。

[FIGURE 10]
The block diagram of the endoscope system suitable for a diagnosis of the metabolism situation of a suture part.

【図１１】
図１０の変形例を示す構成図。

[FIGURE 11]
The block diagram showing the modification in the diagram 10.

【図１２】
従来例の蛍光観察装置の全体構成図。

[FIGURE 12]
The entire block diagram of the fluorescent observation apparatus of a prior art example.

【符号の説明】
１…蛍光観察装置
２…光源装置

[EXPLANATION OF DRAWINGS]
1... fluorescence observation apparatus
2... light source device

３…組織	3... tissue
４…撮像装置	4... image-pick-up apparatus
５…２次元ロックインアンプ	5... two-dimensional lock-in amp
６…画像処理装置	6... image processing device
７…タイミングコントローラ	7... timing controller
８…モニタ	8... monitor
９…レーザ	9... laser
１０…チョッパ	10... chopper
１１…キセノンランプ	11... xenon lamp
１２…第１のフィルタ	12... first filter
１３…回転シャッタ	13... rotation shutter
１４…ダイクロイックミラー	14... dichroic mirror
１６…対物レンズ	16... objective lens
１７…第２のフィルタ	17... 2nd filter
１８…ＣＣＤ	18...CCD
１９…ビデオプロセッサ	19... video processor
２１…マルチプレクサ	21... multiplexer
２２ａ，２２ｂ…フレームメモリ	22a, 22b... frame memory
	23... difference circuit
２３…差分回路	24... integration circuit
２４…積分回路	26, 27... frame memory
２６、２７…フレームメモリ	29... calculation circuit
２９…演算回路	30... superimpose circuit
３０…スーパインポーズ回路	

【図１】

[FIGURE 1]

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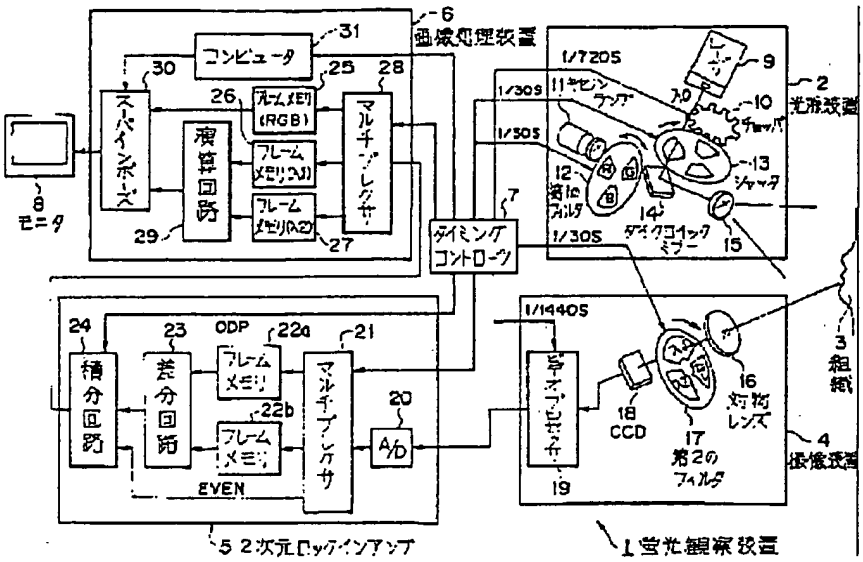


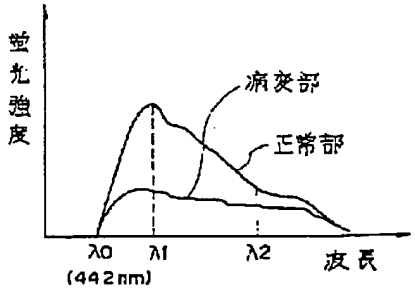
[translation of Japanese text in Figure 1]

also refer to EXPLANATION OF DRAWINGS

25 frame memory (RGB)

28 multiplexer

【図２】 **[FIGURE 2]**



[translation of Japanese text in Figure 2]

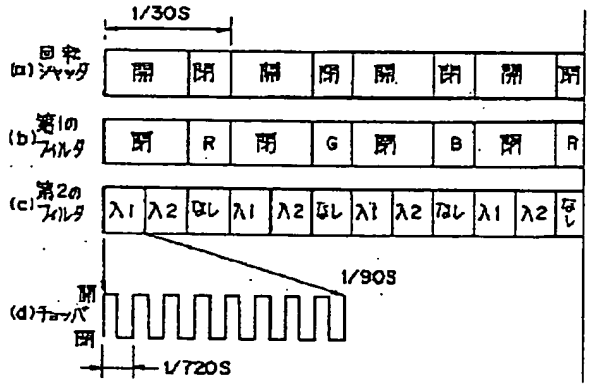
vertical axis: fluorescent intensity

horizontal axis: wavelength

top line: normal region

bottom line: diseased region

【図３】 **[FIGURE 3]**



[translation of Japanese text in Figure 3]

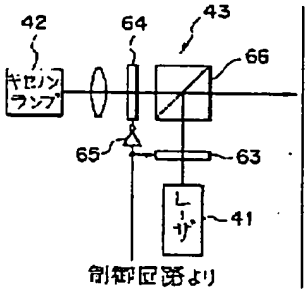
(a) revolving shutter: open, closed, open, closed, ...

(b) 1st filter: closed, R, closed, R, closed, B, ...

(c) 2nd filter: (lambda) 1, (lambda) 2, none, ...

(d) chopper: open, closed

【図７】 **[FIGURE 7]**



[translation of Japanese text in Figure 7]

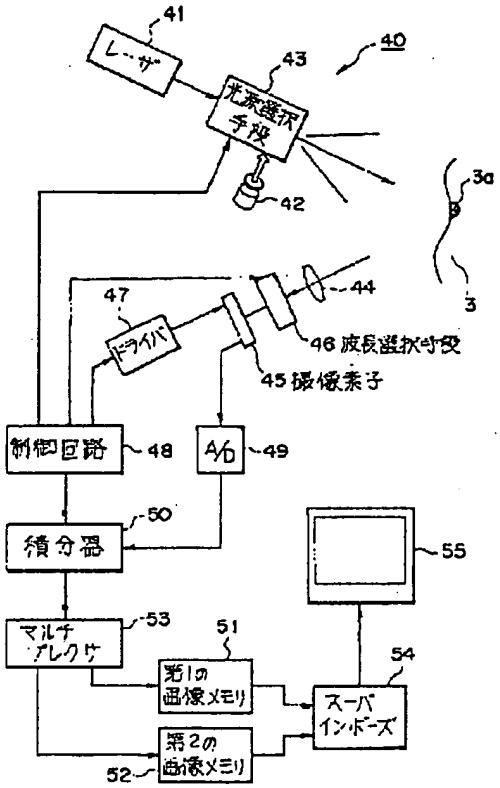
41 laser

42 xenon lamp

into 65 from control circuit

【図４】 **[FIGURE 4]**

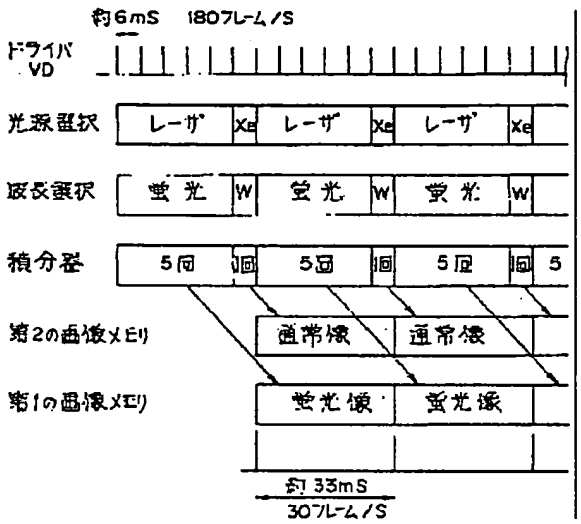
 (C) DERWENT



[translation of Japanese text in Figure 4]

41 laser
43 light source selection means
45 image sensor
46 wavelength selection means
47 driver
48 control circuit
50 integrator
51 1st image memory
52 2nd image memory
53 multiplexer
54 superimpose

【図５】 **[FIGURE 5]**

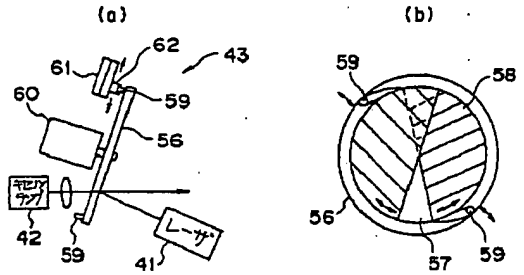


[translation of Japanese text in Figure 5]
roughly 6ms, 180 frames/s

driver VD
light source selection: laser, Xe, laser, Xe, ...
wavelength selection: fluorescent, W, ...
integrator: 5 times, 1 time, ...
2nd image memory: usual image, usual image, ...
1st image memory: fluorescent image, fluorescent image, ...

roughly 33 ms, 30 frames/s

【図6】 **[FIGURE 6]**

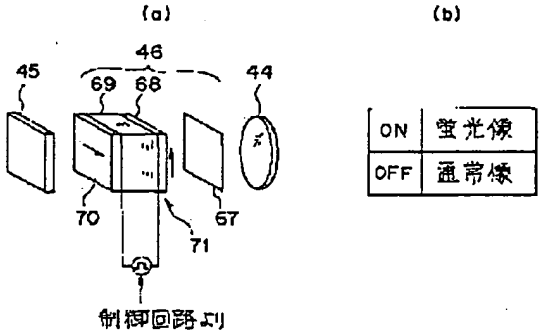


[translation of Japanese text in Figure 6]

41 laser

42 Xenon lamp

【図８】 **[FIGURE 8]**



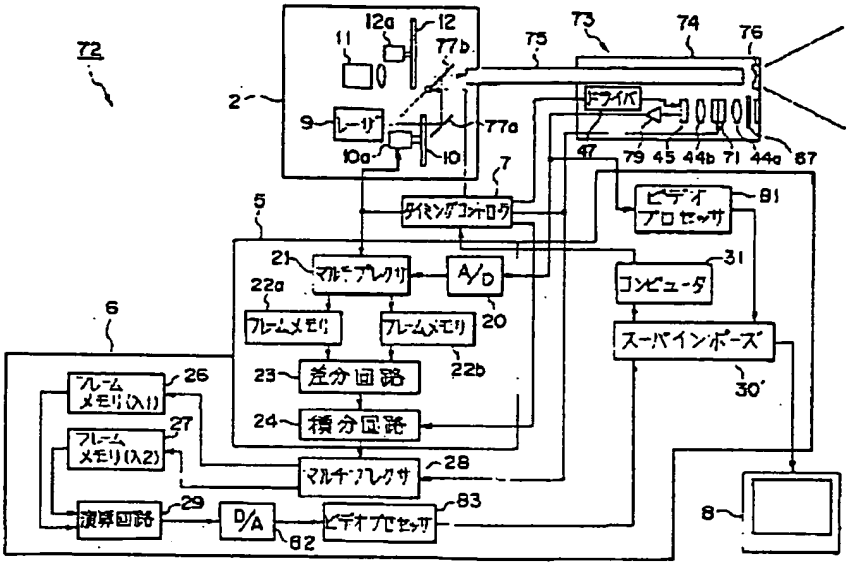
[translation of Japanese text in Figure 8]

(a) from control circuit

(b) ON fluorescent image

OFF usual image

【図９】 **[FIGURE 9]**



[translation of Japanese text in Figure 9]

28 multiplexer
31 computer
47 driver
81 video processor
83 video processor

【図１０】 **[FIGURE 10]**

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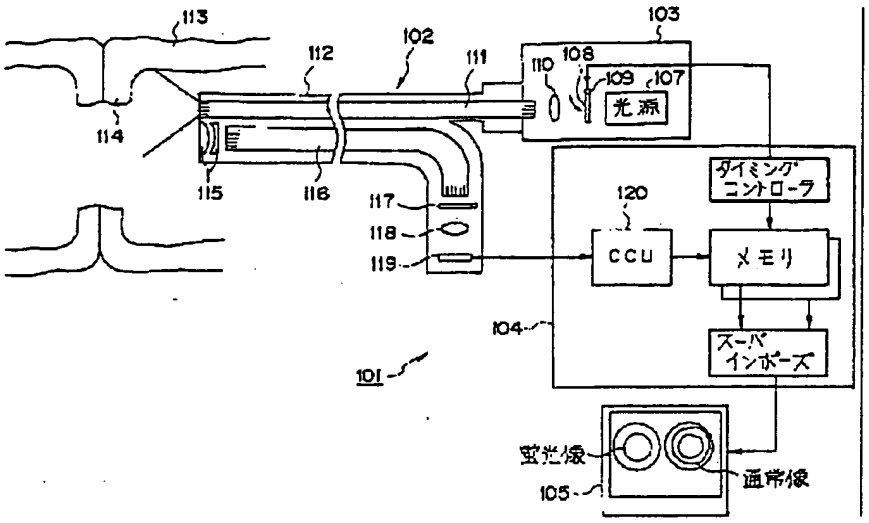
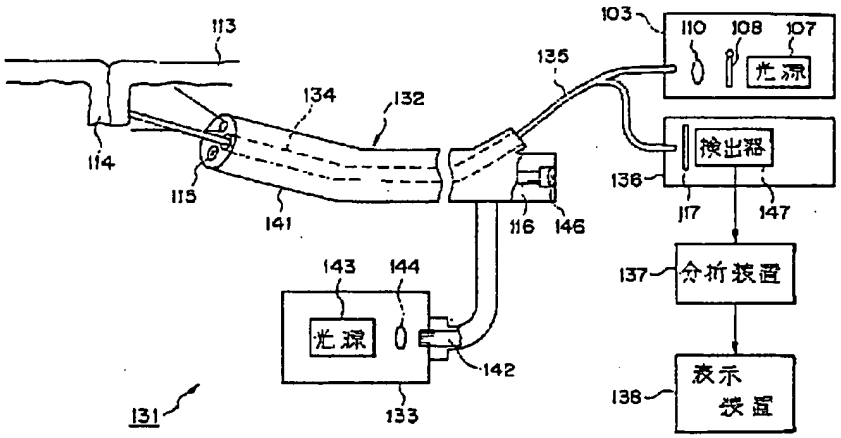


[translation of Japanese text in Figure 10]

inside 105	*left circles*	fluorescent image
	right circles	usual image
next to 120	timing controller, memory, superimpose	
107	light source	

【図１１】 **[FIGURE 11]**

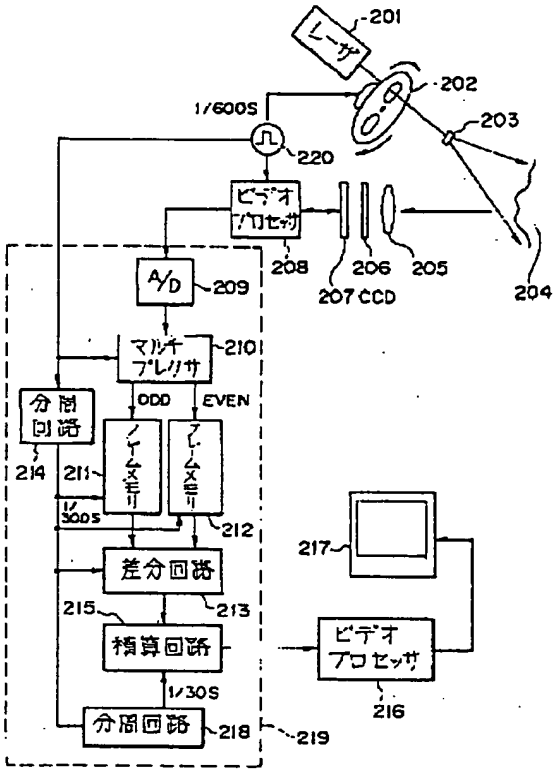


[translation of Japanese text in Figure 11]

107	light source
137	analysis unit
138	display unit

143 light source
147 detector

【図１２】 **[FIGURE 12]**



[translation of Japanese text in Figure 12]

208 video processor
210 multiplexer
211 frame memory ODD
212 frame memory EVEN
213 differencing circuit
214 divider circuit
215 integrating circuit
216 video processor
218 divider circuit

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